CHAPTER 8

GMLS: SECONDARY AND AUXILIARY FUNCTIONS

You should now have a pretty good understanding of the general physical arrangement and operational characteristics of the major guided-missile launching systems (GMLSs). The subject matter of this chapter will continue along those same lines. We will describe the secondary and auxiliary functions performed by the launching systems.

Secondary functions involve the equipments associated with guided-missile jettison and strikedown operations. Auxiliary functions cover a variety of equipment areas. We will only address the major types of fire suppression and environmental control systems. A brief section of general GMLS equipment safety precautions is presented at the end of the chapter. Pay close attention to the terminology used to describe each system.

> **NOTE**
>
> Throughout this chapter, as well as in other areas of this manual, certain equipment or system operating procedures will be presented. This is for general training purposes ONLY. The information presented should NOT be misinterpreted as the absolute step-by-step sequence of events in any case. ALWAYS refer to and use the applicable reference instructions (GMLS publications, maintenance requirement cards, ship doctrines, and so on) when dealing with actual operational procedures.

JETTISONING

LEARNING OBJECTIVES: State the purpose for missile jettisoning, and list the major components and operation of the dud-jettisoning assembly for the Mk 13 Mod 4 and Mk 26 GMLS.

Jettisoning, also known as dud jettisoning, is the act of clearing an unwanted missile from a launcher guide rail by ejecting it overboard. Whenever the firing key is closed, there is never a 100 percent guarantee that every missile will properly ignite and launch under its own power. A dud or misfire condition could exist that may lead to a potentially hazardous situation. Should the missile endanger the safety of the ship and its personnel or interfere with tactical operations, the order to jettison the round could be given. In some cases, however, after an appropriate waiting period, the missile may be safely returned to the magazine.

In any event, the final decision rests with the commanding officer. The orders to prepare to jettison and to actually jettison are relayed to GMLS personnel by the weapons control system (WCS). The launcher and jettison devices are readied for operation. Generally, a piston slowly extends out to contact the missile. The piston then ejects (or pushes) the missile over the side. The ejecting force is usually supplied by a high-pressure pneumatic source.

MK 13 MOD 4 GMLS JETTISON

The Mk 13 GMLS uses a jettison device (fig. 8-1) that is an integral part of the launcher guide arm. Components of the device are located within the forward part of the guide arm and the yoke. (Also see fig. 7-6.) The jettison device is essentially a high-pressure, hydropneumatic ram-type piston. Jettison operations may be performed in the remote, local, or exercise modes as selected by the EP2 panel operator.

Physical Description

The main jettison components in the guide arm are a piston, a beam, a track, two shafts, and a latch. The piston, working from hydraulic and nitrogen pressures, is the propelling force. In extending, the piston moves the beam and the two shafts, pushing the missile from the retractable rail. With the retractable rail retracted, a crossbar receiver on the beam engages the crossbar of the two shafts. The beam, attached to the forward end of the piston and riding on rollers, is guided onto the beam track. The shafts are two tubes that slide into bores within the retractable rail. The crossbar receiver engages the shafts and latches them to the beam. Two pawls below the shafts engage the missile forward shoe. The latch is a spring-loaded valve that extends its plunger into a recess of the beam. The latch locks the beam and jettison piston in their retracted positions.

Other jettison components are in the yoke section of the guide. They include a pressure intensifier pump,

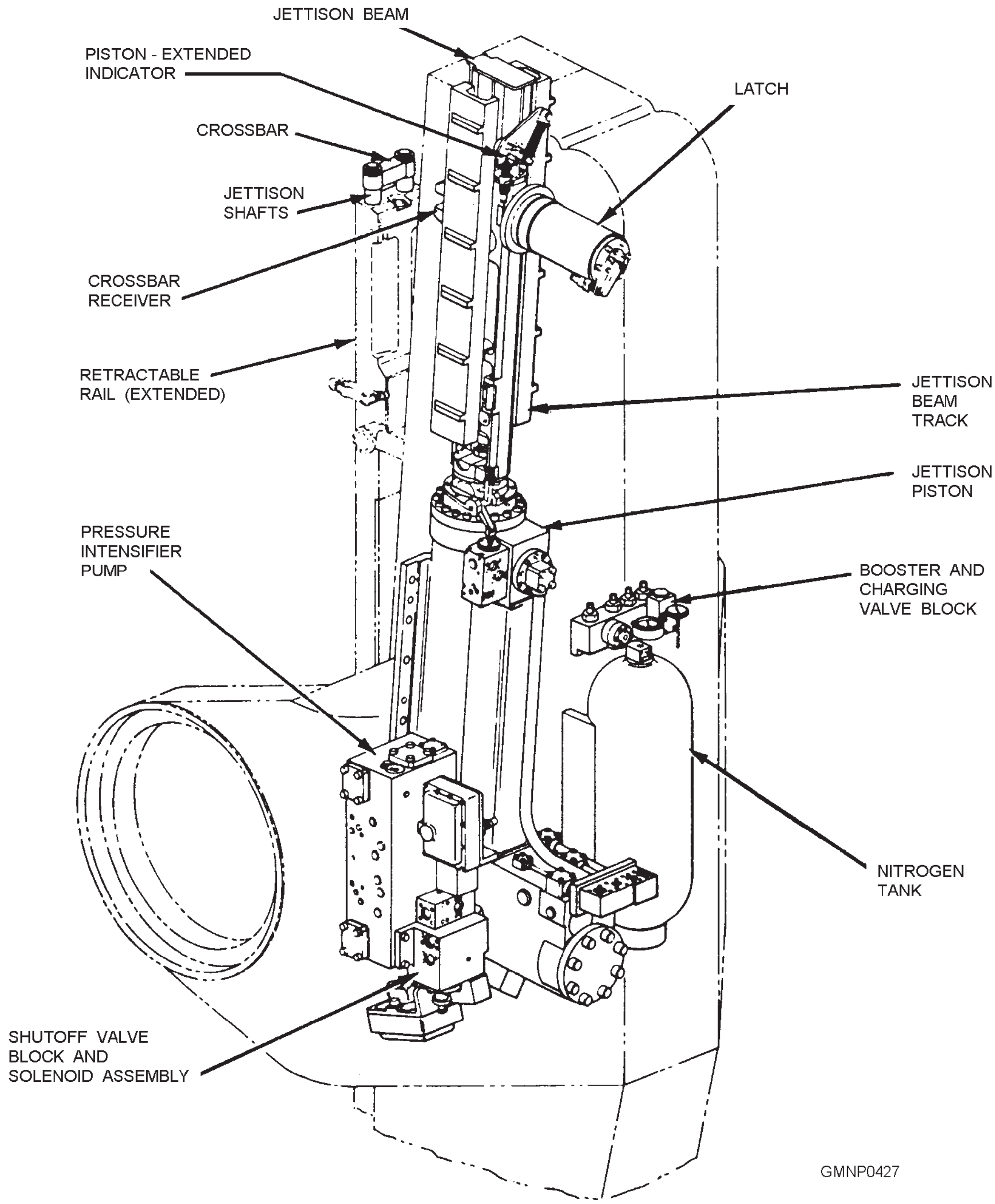

Figure 8-1.—Mk 13 Mod 4 GMLS jettison device.

a nitrogen tank, and a booster and charging valve block. The pressure intensifier pump is a special pumping unit for boosting hydraulic pressure when retracting the jettison piston. The increased hydraulic pressure offsets the high nitrogen pressure used to extend the piston. Attached to the pressure intensifier pump is a shutoff valve block and solenoid assembly. It opens or closes the hydraulic fluid pressure line to the launcher guide components. The nitrogen tank is a steel flask charged with nitrogen. This pressurized gas extends the jettison piston at the velocity needed to eject a missile overboard. The booster and the charging valve block are part of a hydropneumatic unit. This unit also contains a piston and shutoff valves. The valves are used to maintain the nitrogen supply and hydraulic pressure at the proper level for operating the jettison piston.

Portable nitrogen supply cylinders (bottles) and a nitrogen booster pump supply nitrogen to the tank. Supply cylinders normally are charged to only 1,800 psi. This is insufficient pressure to operate the jettison device safely. A manually operated nitrogen booster pump is, therefore, used to increase supply cylinder pressure. The pump increases nitrogen pressure to about 2,400 psi when the nitrogen tank is filled or recharged. The Mk 13 Mod 4 GMLS has a permanently installed unit in the inner magazine structure.

Functional Description

Functionally, the Mk 13 Mod 4 GMLS jettison device is a compact, simple, ready-to-use piece of equipment that is totally independent of the ship's HP air system.

JETTISON REMOTE.—When jettisoning is ordered, the launcher captain activates the REMOTE DUD JETTISON switch on the EP2 panel. Control system circuits automatically cause various guide arm components to set up for jettisoning. The fin opener arm assembly retracts. The forward-motion latch unlocks, and the arming device extends. As the retractable rail retracts, the crossbar between the jettison shafts enters the slot in the crossbar receiver. The guide arm is then mechanically prepared for the jettison operation.

The remote circuits also affect the launcher power drives. Train control is transferred from the fire control system (FCS) computer to synchros in the launching control system. Elevation control is switched to a remote FCS gyrocompass. In response, the launcher automatically moves to a jettison position that aims the missile seaward. Train bearing will be either directly port or starboard. It is controlled by stationary position orders from the digital director in the EP3 panel to the launcher synchros in the train and elevation receiver regulators. Elevation angle will be 36°40' relative to the horizon. As the ship rolls and pitches, gyrocompass signals will maintain the 36°40' elevation angle. This angle ensures the jettisoned missile will clear the ship.

Extend Jettison.—When the launcher synchronizes to a jettison position, the EP2 operator reports ready and awaits the final order. Pushing the DUD JETTISON-JETTISON push button on the EP2 initiates the extend and jettison cycles.

The extend dud-jettison solenoid is energized. Hydraulic fluid pressure (1,500-1,600 psi) from the launcher guide power unit is applied to the front of the jettison latch. However, at this time the latch cannot be retracted. That is because nitrogen pressure (at 2,400 psi) is constantly applied to the back of the jettison piston. This pressure forces the jettison beam forward (slightly) and places a bind on the latch. Thus normal hydraulic fluid pressure cannot overcome the higher nitrogen pressure. The jettison latch remains extended at this point in the extend sequence.

Hydraulic fluid is, therefore, ported around the latch. The fluid is directed to a pressure intensifier valve in the pressure intensifier pump. A pumping action takes place as this valve is made to shift rapidly back and forth. The principle behind this action involves the conversion of an applied pressure with great volume by a large area piston into a greater pressure with less volume by a smaller area piston. Hydraulic fluid pressure is, thus, intensified to more than 8,000 psi and is ported to the front of the jettison piston. Intensified fluid pressure overcomes the nitrogen pressure behind the piston. The jettison piston and beam retract slightly to release the bind on the latch. Normal hydraulic fluid pressure may then retract the jettison latch.

As the latch retracts, the output of the intensifier pump is isolated and stopped. Nitrogen pressure behind the jettison piston causes it to creep forward. Its speed is restricted by an orifice. Movement of the piston cams the two jettison pawls into contact with (behind) the forward missile shoe. The forward-motion latch is displaced, and valves are shifted to remove creep control. The piston accelerates and propels the missile seaward.

At the end of piston travel, a buffering action takes place to slow and stop the piston and beam. Also, an interlock switch is actuated to provide the launcher captain with an EXTENDED lamp indication.

Retract Jettison.—After the extended lamp lights, the launcher captain pushes the DUD JETTISON RETRACT push button. A solenoid energizes to activate the intensifier pump once again. A retract cycle requires a large volume of hydraulic fluid. A special isolation valve provides this large supply by closing and isolating hydraulic fluid from the other components of the guide arm. This action is necessary to prevent these components from reducing the volume of fluid available to the intensifier pump.

Intensified hydraulic fluid is then applied to the front of the extended piston. As the jettison piston and beam retract, nitrogen is forced back into the nitrogen tank. In approximately 15 seconds, the piston reaches its fully retracted position. The latch engages the beam and activates an interlock switch. The control system indicates RETRACTED.

The isolation valve shifts to make hydraulic fluid available to the other guide components. The forward-motion latch locks, and the arming device retracts. The retractable rail reextends; the launcher slews to the load position, ready for future operations.

JETTISON LOCAL.—If the remote elevation order signal is not available from the FCS gyrocompass, the launcher captain switches to LOCAL DUD JETTISON. Fixed position synchros in the EP2 then supply the elevation signal. Ship roll compensation consists of the launcher captain watching a clinometer bubble. The jettison operation is timed to coincide with a down roll. All other operations are the same.

JETTISON EXERCISE.—For maintenance testing, the EP2 operator shifts the system to the STEP-EXERCISE mode. Step push buttons must be activated to extend the arming device and retract the retractable rail.

With the guide arm empty, the rail-loaded indicator plunger and a hydraulic valve are extended. The extended valve ports hydraulic fluid to a throttle valve. This valve restricts the flow of hydraulic fluid to the jettison piston and limits the speed of piston travel. The reduced speed prevents equipment damage that would occur under a no-load condition. Retraction of the jettison piston in the exercise cycle is the same as that in an actual jettison operation.

MK 26 GMLS JETTISON

The Mk 26 GMLS has two jettison devices. They are deck-mounted at an angle to the launcher platform at the A and B dud-jettison positions. The two units are hydromechanically extended and retracted. They use an explosive gas generator to provide the ejecting force. Both the missile and an expendable piston assembly jettison over the side. Jettison operations start with a preparatory order from the ship's combat system (SCS). The main control console (MCC) operator in the integrated control station (ICS) controls all subsequent actions. The jettison devices of the various Mk 26 GMLS mods are identical.

Physical Description

Above the deck, the jettison mounting bracket supports, encloses, and protects the upper jettison components (fig. 8-2). Anti-icing fluid is circulated around the expendable piston cap to prevent ice buildup. A locking post and screw secure the gas generator cover to the bracket.

Below the deck, the 4-foot jettison housing cylinder contains the extender mechanism and the expendable piston assembly. The upper end of the cylinder is thicker than the lower end. It must be thicker to withstand the explosive force developed by the gas generator. A motor housing is bolted to the back of the cylinder. It contains a small bidirectional hydraulic motor that is controlled by a solenoid valve assembly.

The extender mechanism consists of an extender screw, extender nut, and extender sleeve. The extender screw is coupled to the output shaft of the hydraulic motor. The extender nut is threaded onto the screw and bolted to the extender sleeve. The extender screw is rotated counterclockwise (to extend) or clockwise (to retract) by the motor. The extender nut and sleeve (with the expendable piston assembly) travel out or in on the threads of the screw.

The extender sleeve serves as the barrel for the expendable piston assembly. A key and keyway prevent the sleeve from turning as the mechanism is extending or retracting. Gas ports in the aft section of the sleeve permit expanding gases from the fired gas generator to enter the sleeve. Gas pressure fills the sleeve up to the expendable piston. Only the piston assembly is propelled overboard.

The expendable piston assembly weighs about 75 pounds and fits inside the extender sleeve. A split lock ring is bolted to the piston cap. It attaches the cap to the piston sleeve and the piston assembly to the extender sleeve. A piston plug is inside the piston sleeve. It serves as a guide for the positioner rod of the safety mechanism. The piston plug is also a header for the expanding gas pressure.

The gas generator contains an electrically ignited explosive charge. When the generator is fired, expanding gases propel the piston assembly and a missile from the guide rail. The generator is a one-shot device that must be replaced after each firing.

What if a gas generator accidentally fired while the jettison device was retracted? A pressure safety relief mechanism is built into the unit. Components of the mechanism will safely vent the expanding gases to the atmosphere. They also prevent the piston and other metal pieces from ejecting outward.

When the extender sleeve is retracted, a blow-in plug assembly in the wall of the sleeve aligns under the gas generator. The assembly is designed to collapse into the forward chamber of the expendable piston. Gas pressures act only on the front side of the piston plug. That keeps the piston assembly inside the extender sleeve.

Two headless straight pins are staked at right angles to the center of the positioner rod. They serve as a

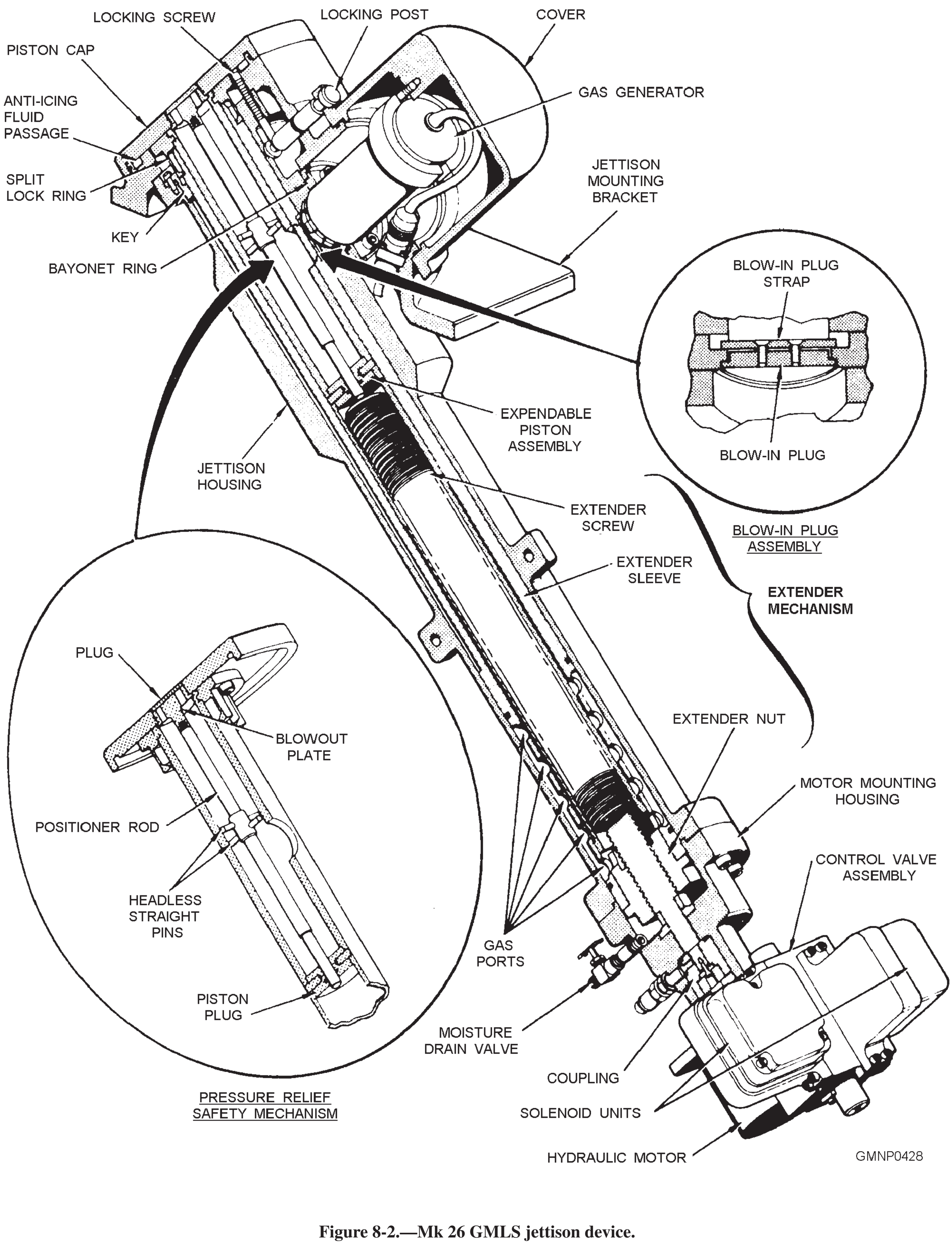

Figure 8-2.—Mk 26 GMLS jettison device.

capture cage for pieces of the blow-in plug assembly. A rupture disc (or plug) is in the center of the piston cap. It breaks (from internal pressure) and allows the gases to escape. Normally intact, the ruptured disc keeps moisture out of the jettison device.

Functional Description

When ordered to prepare for jettison operations, the MCC operator presses the RSR/RAIL SELECTION-A or -B and POINTING SELECTION-JETTISON push buttons. Automatically, the launcher slews to the correct position and readies itself for jettisoning. For an antiair warfare (AAW) missile, the AAW arming device disarms. The two firing contactors and the AAW contactor retract. For an antisubmarine warfare (ASW) missile, the ASW contactor retracts. The retractable rail extends, and the ASW fire through latch unlocks.

EXTEND JETTISON DEVICE.—As the launcher synchronizes to the jettison position and the guide arm components are correctly positioned, jettison device operations begin. Jettison control circuits automatically energize control valve solenoids. The solenoids start the hydraulic-mechanical actions to extend the extender sleeve and piston. When the sleeve leaves its retracted position, the train and elevation power-drive brakes set. They hold the launcher aligned to the jettison position. The extender mechanism drives the expendable piston to within one-half inch of the tail cone of the missile and stops (fully extended).

JETTISON FIRING.—With all jettison circuit interlocks satisfied, a ready-to-jettison indication is given on the MCC. When the jettison order is received, the operator depresses the JETTISON FIRE push button. The firing circuits apply 20 VAC to the gas generator squibs. The generator ignites and jettisons the missile and expendable piston assembly.

RETRACT JETTISON DEVICE.—The MCC operator starts retract operations by depressing the JETTISON DEVICE-RETRACT push button. The extender mechanism returns the sleeve to its retracted position. When the sleeve is fully retracted, control system circuits automatically release the train and elevation power drive brakes. The ASW or AAW aft shoe latch retracts. The AAW rail segments also retract to clear the guide arm for the next missile. The MCC operator may return the system to normal operation.

Jettison operations are usually performed in the auto-load mode. For maintenance purposes, the step-load mode is used. All component operations must be initiated manually. The firing circuit to the gas generator may be checked but the unit is not ignited. The gas generator is classed as a high-explosive hazard. Handling and stowing procedures are conducted within strict adherence to applicable safety regulations.

STRIKEDOWN

LEARNING OBJECTIVES: Identify the major components of the major GMLS systems, and describe the operational procedures for strikedown of these systems.

Strikedown is a term associated with special GMLS equipments, operational procedures, and modes of system control. They are used during a missile onload or missile offload process. An onload operation transfers missiles from an outside source into the missile magazine. An offload operation is just the opposite.

Strikedown, for our purposes, is strictly an in-house GMLS operation. How a missile is transferred between a supplying activity and a receiving activity comes under the topic of replenishment. As GMs, we are generally not responsible for the actual replenishment actions. However, we must be aware of the basic procedures. Our main task is to move the missile between the ship's replenishment area and the GMLS strikedown area safely.

Guided-missile replenishment can be performed in various ways. Underway replenishment (UNREP) can be in the form of a connected replenishment (CONREP) or a vertical replenishment (VERTREP). For CONREP, missiles are moved between ships on appropriate riggings or highlines. For VERTREP, a helicopter is used to deliver/remove missiles from the ship. VERTREP may also be performed while the ship is at anchorage and, in some rare cases, pierside. A crane is used during dockside or lighter replenishment. (A lighter is an ammunition barge.) The crane is the simplest of replenishment methods. We will examine replenishment methods in greater detail later. For now, we will stay with the strikedown operations performed by the GMLSs.

MK 13 MOD 4 GMLS STRIKEDOWN

The strikedown onload and offload operations of the Mk 13 Mod 4 GMLS require special strikedown handling equipment, which must be installed on the launcher. This equipment provides a pneumatically driven chain mechanism to transfer the missile between the guide arm and transfer dolly (fig. 8-3). Figure 8-4

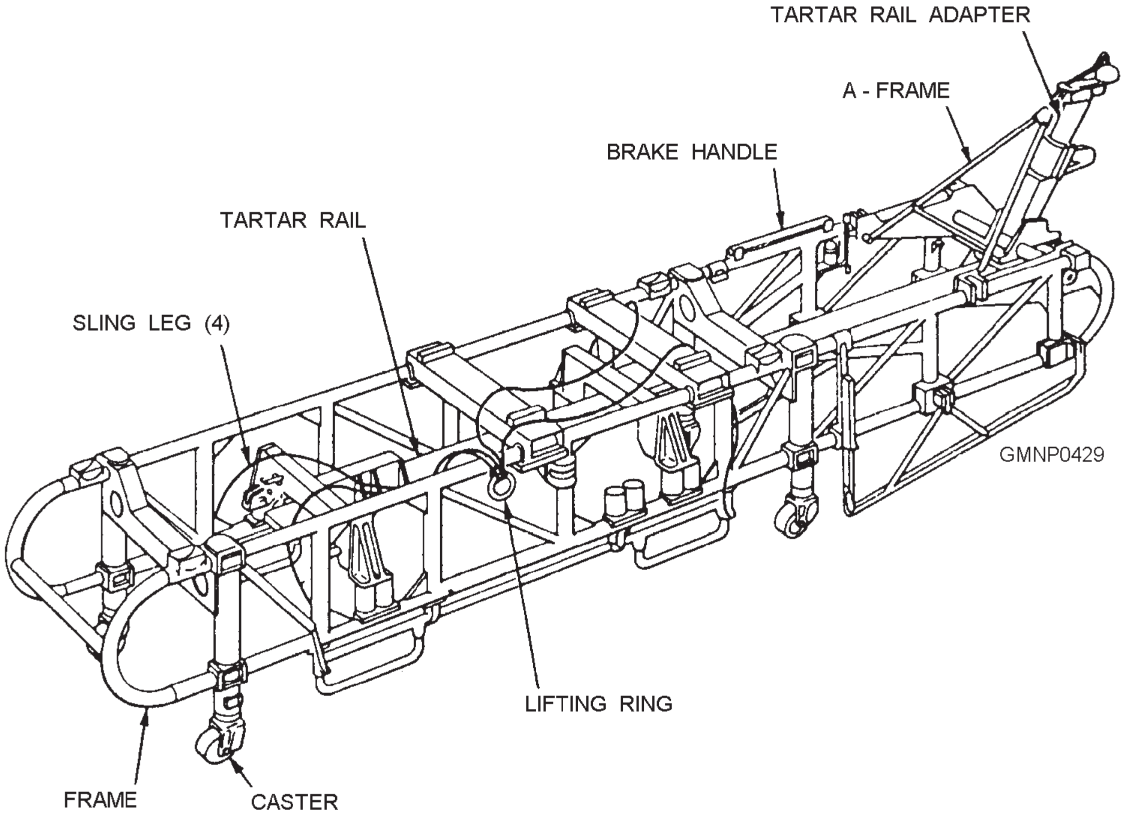

Figure 8-3.—Transfer dolly.

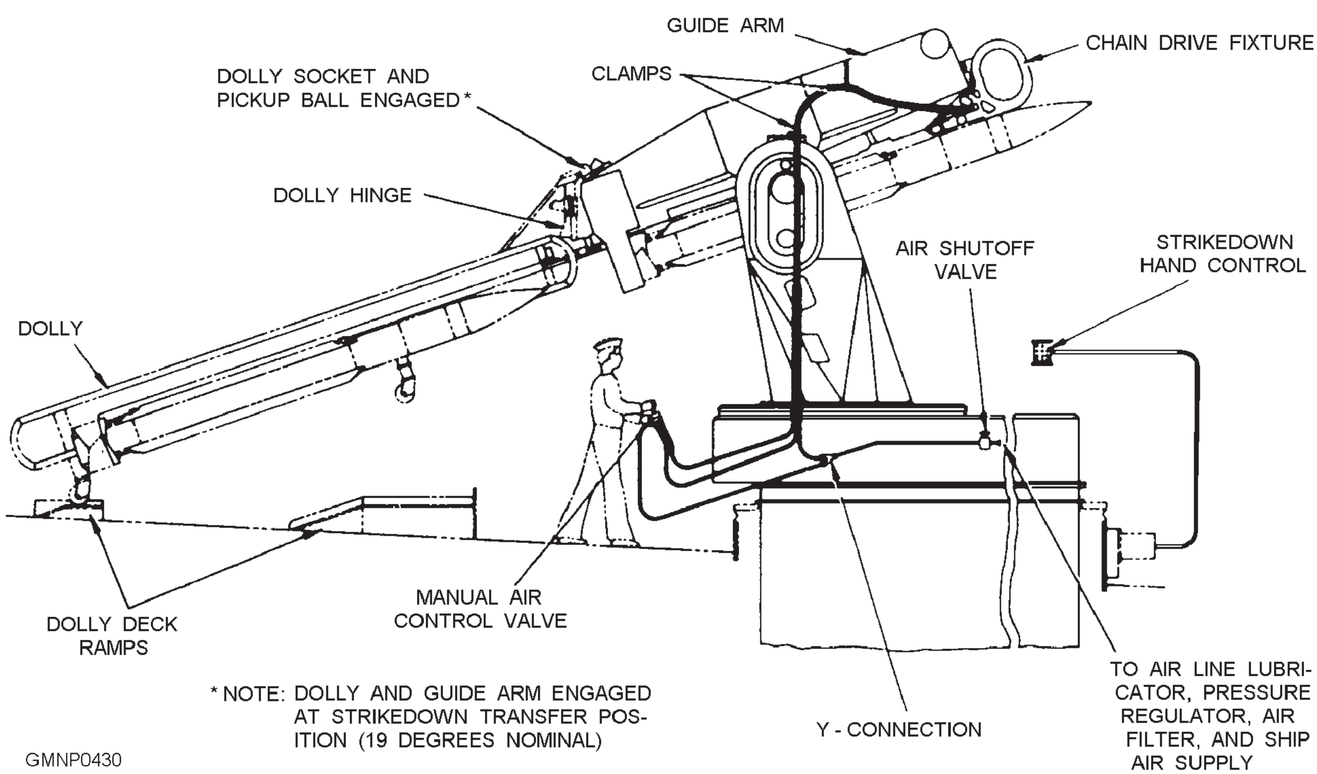

Figure 8-4.—Mk 13 Mod 4 GMLS strikedown operations.

shows a Mk 13 Mod 4 strikedown operation with strikedown handling equipment installed.

Transfer dolly handling and most launcher and guide arm component movements are initiated and controlled by system personnel topside.

Strikedown Gear

The special Mk 13 Mod 4 GMLS strikedown gear consists of a hand-control unit, a chain-drive fixture, and air supply components. This gear is stowed near the launcher area and must be set up before onload operations begin. Strikedown air originates from the ship's HP air system. At the GMLS, HP air is reduced and regulated to the low-pressure requirements (about 100 psi) of the equipment. This arrangement provides the strikedown gear with sufficient operating volume and pressure. In the following discussion, we will call this reduced HP air "supply air."

STRIKEDOWN HAND CONTROL.—The strikedown hand-control unit is a hand-held portable switch box. It is sometimes referred to as the deck control box. The operator of this unit can control train and elevation launcher movements, the elevation positioner (latch), and both power-drive brakes.

The box has six toggle switches (five are functional) and six indicating lamps. A detachable cable connects the box to the strikedown jack receptacle of the GMLS. The receptacle is mounted on the stand or on a bulkhead outside the launcher control room. (Location varies between mark and mod of GMLS.) Figure 8-5 shows a typical hand-control unit. Note what functions are controlled and indicated by the switches and lamps.

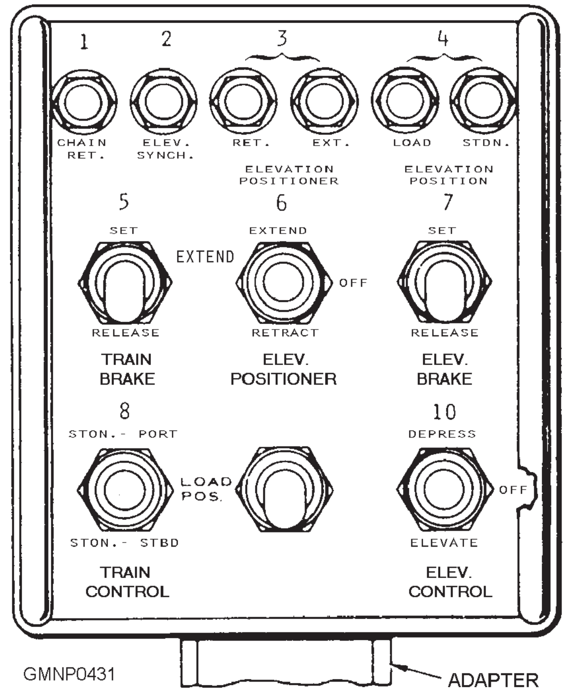

Figure 8-5.—Typical strikedown hand-control unit.

CHAIN-DRIVE FIXTURE.—The chain-drive (or strikedown) fixture is shown in figure 8-6. It is installed and locked to the front of the guide by two

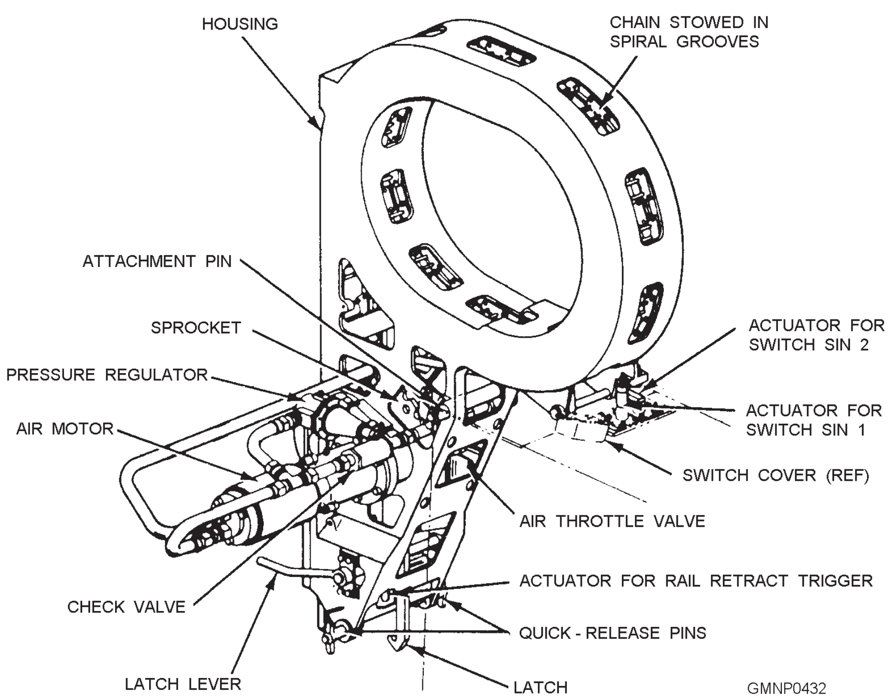

Figure 8-6.—Chain-driven fixture.

quick-release pins. Probes on the fixture actuate a strikedown-fixture-on-launcher interlock switch and deflect the retractable rail trigger. That prevents any interference between the trigger and the strikedown chain.

The link-type chain is guided by the forward shoe tracks of the retractable rail. A pair of spring-loaded latches on the forward end of the chain engage the forward missile shoe. An air motor on the fixture drives the chain through a simple gear reduction and sprocket mechanism. As the chain is made to extend or retract, it pulls the missile up to the guide arm or lowers it to the dolly.

Air motor operation is controlled by a pressure-regulating valve and an air-throttle valve. Both components are mounted on the chain-drive fixture. The pressure regulator reduces supply air to about 20-25 psi for a chain extend cycle. This low pressure drives the air motor at a slow extend speed. It also prevents the chain links from buckling when the latches engage the missile shoe. The air-throttle valve serves two purposes. First, it functions as a directional valve controlling the direction of motor rotation. Second, it controls the speed of chain travel near its extended and retracted limits. The valve throttles or reduces the air pressure available to the drive motor.

MANUAL AIR-CONTROL VALVE.—The manual air-control valve is a three-position, hand-operated valve (see fig. 8-4). Air line hoses connect it to a convenient ship supply air source near the launcher. Other hoses connect it to the pneumatic components on the chain-drive fixture.

The air-control valve is used to start, stop, and select the direction of chain travel. When the valve is in the NEUTRAL position, supply air is isolated from the drive fixture to stop the chain. When the valve is in the EXTEND or RETRACT position, supply air is ported to shift the air-throttle valve appropriately.

Strikedown Preparations

The EP2 panel must be activated to prepare for an onload operation. The launcher is moved to and secured at a convenient location to install the strikedown gear. Additionally, the launcher rail must be extended, the arming device retracted (disarmed), and the aft-motion latch retracted.

After the chain-drive fixture and the supply air hoses are attached, the EP2 operator activates the system and (carefully) returns the launcher to a LOAD position. The GMLS is secured once more. Topside, the deck control box is connected to its receptacle. The EP2 operator activates the GMLS, selects step control and strikedown, and retracts the train positioner. All subsequent launcher movements are controlled by the deck control box operator.

Strikedown Onload Operations

As the loaded transfer dolly arrives on board, the deck control operator assumes control. The train brake is released, and the strikedown port (or starboard) train control is selected. Fixed-position synchros drive the launcher to the predetermined strikedown position. When the launcher arrives at the strikedown position, the operator resets the train brake.

When ready to engage the dolly, the operator retracts and releases the elevation positioner and brake. The guide slowly depresses from the 90 degree load position when the elevation control switch is actuated. The guide mates with and picks up the dolly. The guide continues to depress until the elevation strikedown angle is reached. The operator resets the elevation brake and extends the positioner. Chain-drive operations can then begin.

EXTEND CHAIN.—The manual air-control valve handle is turned to EXTEND. This ports supply air to shift the air-throttle valve. From the air-throttle valve and the pressure regulator, 20-25 psi air causes the air motor to extend the chain slowly. The chain travels the length of the retractable rail of the launcher. It also extends along a portion of the guide rail of the dolly to reach the forward missile shoe.

Near the end of the chain travel, a cam on one of the chain links contacts and shifts linkage connected to the air-throttle valve. The main air port of the valve closes. However, through a restricting orifice, supply air continues to reach the motor. As a result, chain-drive speed is reduced even further. When the latches of the chain engage the forward missile shoe, chain movement stops. The air-control valve handle is returned to its NEUTRAL position.

System personnel visually verify that the spring-loaded chain latches have fully engaged behind the forward shoe of the missile. If the latches are only partially engaged, the missile may break loose as the strikedown chain is retracted. The missile will slide down the rail, shear off the shoe plate on the dolly, and drop on deck. Do not even hang around to explain that one to the chief!

RETRACT CHAIN.—To move the missile onto the guide, system personnel must shift the manual air-control valve handle to RETRACT. Full supply air pressure drives the motor at this time, and the missile is pulled onto the guide arm. As the aft shoe of the missile nears the forward-motion latch in the guide, another chain cam shifts the air-throttle valve. An orifice restricts air flow to slow motor speed again. Movement stops when the aft shoe of the missile contacts the forward-motion latch. The aft-motion latch automatically extends behind the aft shoe, and the manual air-control valve handle is turned to NEUTRAL.

After verifying that the aft-motion latch has fully extended, system personnel release the two chain latches. That is done by depressing a latch lever. See figure 8-6. The manual air-control valve handle is turned to RETRACT again. The chain is returned to its stowed position in the fixture. The manual air-control valve handle is placed in NEUTRAL to conclude air-drive operations.

Return Launcher to Load

The EP2 operator is instructed to select the unload mode. An empty cell in the ready service ring (RSR) is indexed to the hoist station. The deck control operator releases and retracts the elevation brake and positioner. The guide is elevated slowly to the 90 degree load/unload position, disconnecting from the dolly as it travels. When the dolly is rolled clear, the deck control operator releases the train brake. The launcher slews to align with the blast door.

The EP2 operator takes control and proceeds with normal unload operations. The identification probe of the fin opener arm assembly must be extended to identify the missile type on the guide arm. If strikedown operations are completed, the deck control box is disconnected and replaced by a dummy plug. This device restores full GMLS control to the EP2 panel. The launcher is moved to a convenient location for removal of the strikedown gear.

Strikedown Offload Operations

Strikedown offload operations are basically the reverse of onload operations. The one difference concerns the aft-motion latch of the guide arm. Control system circuits normally prevent the aft-motion latch from retracting with a missile on the rail unless the hoist pawl is extended and engaged.

During a strikedown offload operation, the aft-motion latch is retracted with a special tool inserted into a slot on the fixed rail. The tool is turned manually to simulate the presence of the hoist pawl. The EP2 operator may then retract the aft-motion latch. The missile can then be lowered onto the transfer dolly.

MK 26 GMLS STRIKEDOWN/ INTERTRANSFER

The Mk 26 GMLS strikedown/intertransfer system is used for strikedown onloads and offloads. It is also used for intertransfer movement of missiles between RSRs. The Mk 26 GMLS is adaptable to all standard replenishment methods.

The strikedown/intertransfer system can be divided into two primary equipment areas. The strikedown/ intertransfer mechanism is the main component of the system. It functions above and below deck. Components on the strikedown end of the RSRs work with this mechanism in transferring missiles. The other equipment area involves the portable, on-deck handling equipments. Different equipments are used for AAW and ASW rounds.

Strikedown/Intertransfer Mechanism

The strikedown/intertransfer mechanism moves the missiles between the deck and magazine and from RSR

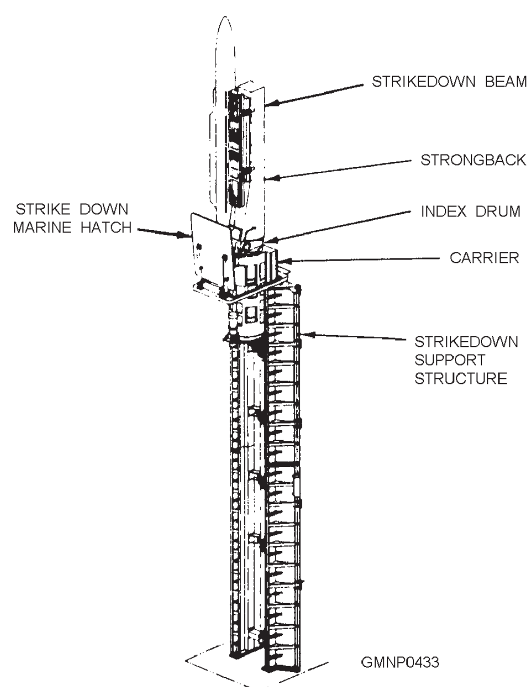

Figure 8-7.—Mk 26 GMLS strikedown/intertransfer mechanism.

to RSR. The mechanism consists of six major assemblies, as shown in figure 8-7.

The strikedown support structure mounts the equipment used to raise and lower the carrier assembly. The carrier assembly rides up and down on guide rails, and it is moved by a threaded screw shaft. The shaft is rotated by a small hydraulic motor.

The index drum is a major subassembly of the carrier. It is mounted on top of the carrier and supports the strikedown beam assembly. Hydraulic components of the index drum serve to position the strikedown beam. When the carrier assembly is in the magazine, the index drum can be rotated 60° on either side of the centerline. This rotation aligns the strikedown beam to the A-RSR or the B-RSR. When the carrier assembly is raised to deck level, the index drum can be rotated 80° on either side of the centerline. This rotation aligns the strikedown beam to the A-receiver or B-receiver positions on deck. At all five positions, the index drum is latched in place.

Components within the index drum also elevate and depress the strikedown beam. The strikedown beam is hinged to the index drum. The beam is depressed to horizontal to pick up a missile from or deliver it to the on-deck handling equipment. It is elevated to vertical and latched to ride up and down the support structure.

A strongback assembly (fig. 8-8) hangs from the strikedown beam. It is used to secure a missile to or release it from the beam. The strongback is capable of extending and retracting at both the vertical and horizontal positions. Four separate openings in the strongback accept the forward and aft shoes of the AAW and ASW missiles. Shoe latches within these openings secure the missile to the strongback.

When the strikedown beam is horizontal, the extended strongback is capable of some small vertical and lateral movements. The mobility of the extended strongback enables it to align itself to the missile shoes. When the strikedown beam is vertical, the extended strongback is only allowed a small lateral movement. When the strongback is fully retracted to the beam, it is latched securely in place.

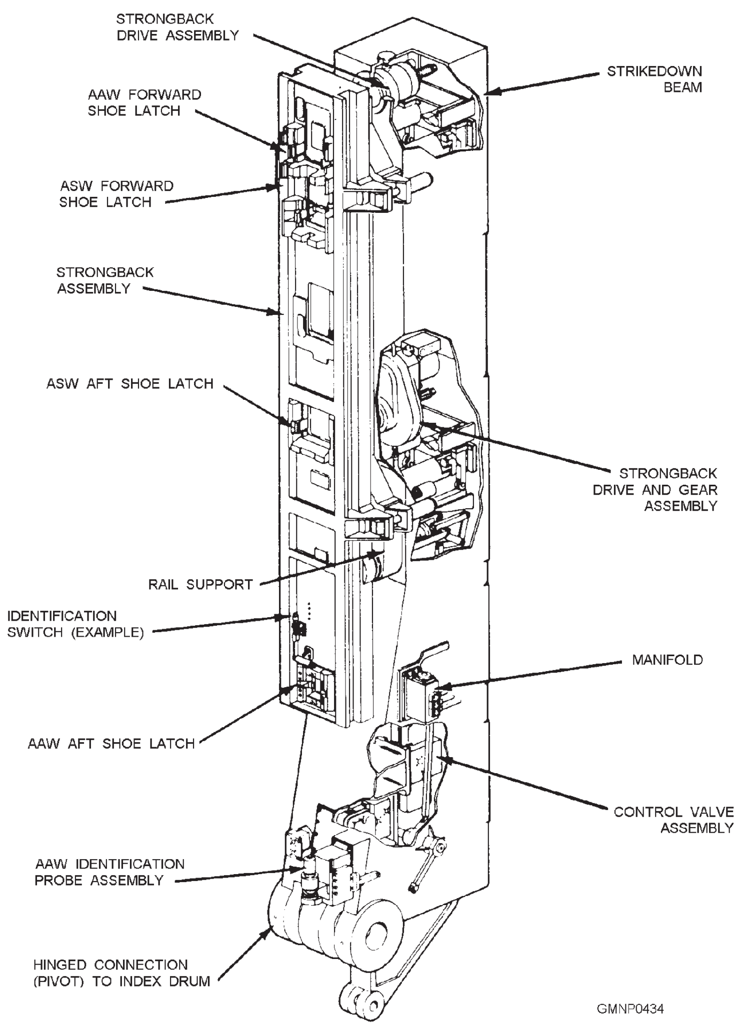

Figure 8-8.—Strikedown beam and strongback assemblies.

The strikedown beam also serves to identify the missiles to the control system. The identification takes place through various proximity switches and an AAW identification probe. Missile group and type information is sent to the ICS even before the missile is lowered to the magazine.

The strikedown marine hatch (refer to fig. 8-7) is the last major component of the strikedown/intertransfer mechanism. The hatch is hydraulically opened and closed by the MCC operator. A strikedown control panel is mounted to the underside of the hatch. When the hatch is opened for strikedown operations, the panel is exposed. This panel permits local control of the strikedown operations performed on deck. Note the functions of the switches and lamps of the panel, as shown in figure 8-9.

The strikedown/intertransfer mechanism receives its hydraulic fluid supply from either the A- or B-RSR/hoist power-drive accumulator system. A manual transfer valve is positioned to select A-side or B-side supplies. The fluid from one system is not allowed to intermix with the other.

On-Deck Strikedown Equipment

The Mk 26 GMLS uses a variety of special on-deck handling equipments. They correctly align and position AAW or ASW missiles to the strongback of the strikedown beam.

Mounted flush in the strikedown area deck are two piston assemblies. They are located about 80° on either side of the strikedown beam centerline. One is for A-side operations, and one is for B-side operations. These piston assemblies are known as the receiver or positioner pistons. They also receive hydraulic fluid supply from the selected RSR/hoist accumulator system. The receiver pistons serve to raise and lower the missile between the deck and extended strongback. This operation is controlled by the on-deck strikedown control panel operator.

AAW HANDLING EQUIPMENT.—AAW-type missiles are shipped to a Mk 26 GMLS in the same transfer dolly used by other Tartar systems. But here any similarity ends. To orient an AAW missile to the strikedown beam properly, the Mk 26 GMLS uses two special devices: the AAW dolly deck track and the AAW missile receiver beam. These portable equipments are used to transfer a missile between a transfer dolly and the strikedown mechanism.

AAW Dolly Deck Track.—The AAW dolly deck track is shown in figure 8-10. It serves to guide and secure a transfer dolly over the in-deck receiver piston. When the dolly arrives on deck, it is pushed up the wheel ramps and guided along the long deck track channel. The dolly is locked in place by forward and aft wheel stops (pins).

Two alignment lever handles are used to shift the track and dolly laterally. This action aids in aligning the shoes of the missile to the AAW receiver beam.

AAW Receiver Beam.—The AAW missile receiver beam is shown in figure 8-11. It is used to transfer the missile between the transfer dolly and the strikedown beam. The beam is connected and secured to the receiver piston. It is allowed some "floating" movement to aid in missile alignment.

Raising the receiver piston transfers an AAW missile from a dolly to the receiver beam. (Maximum travel is about 5 inches.) The bottom shoes of the missile enter the forward- and aft-shoe receptacles in the beam. The manual lever on the beam is turned to move a "finger" in the aft-shoe receptacle. This finger, in contact with the aft missile shoe, shifts the missile. As the missile shifts, its upper shoes are disengaged from the transfer dolly rail. At the same time, the lower shoes are engaged to the receiver beam. The receiver piston is then lowered, and the transfer dolly is cleared from the area. An offload procedure is just the opposite.

ASW HANDLING EQUIPMENT.—ASW-type missiles are shipped to a Mk 26 GMLS in Mk 183 shipping containers (instead of transfer dollies). A special piece of equipment is used to transfer an ASW missile between its shipping container and the strikedown beam. This device is called the ASW container receiver plate (fig. 8-12). The ASW receiver plate is secured to the receiver piston. It also has some

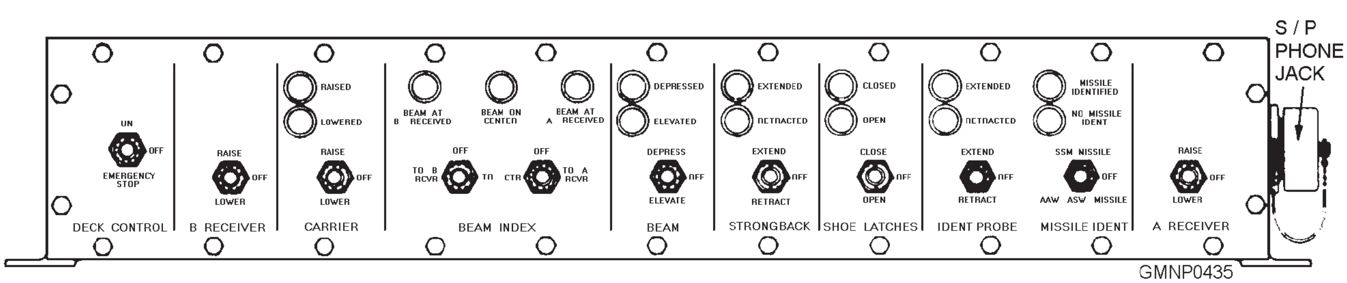

Figure 8-9.—On-deck strikedown control panel; front panel.

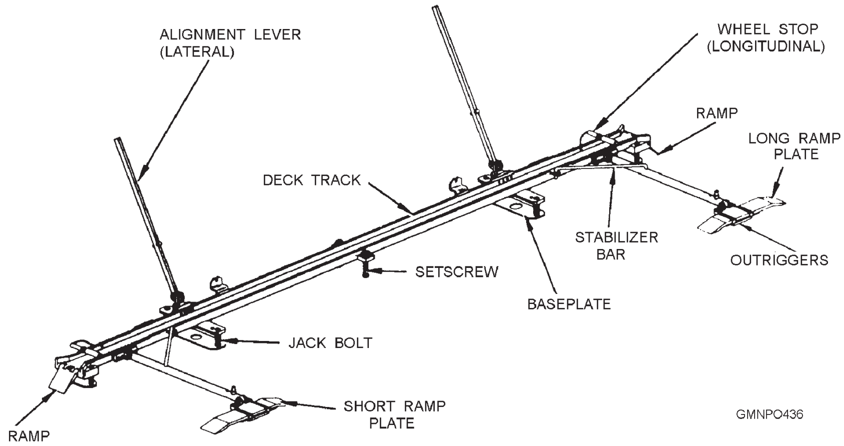

Figure 8-10.—AAW dolly deck track.

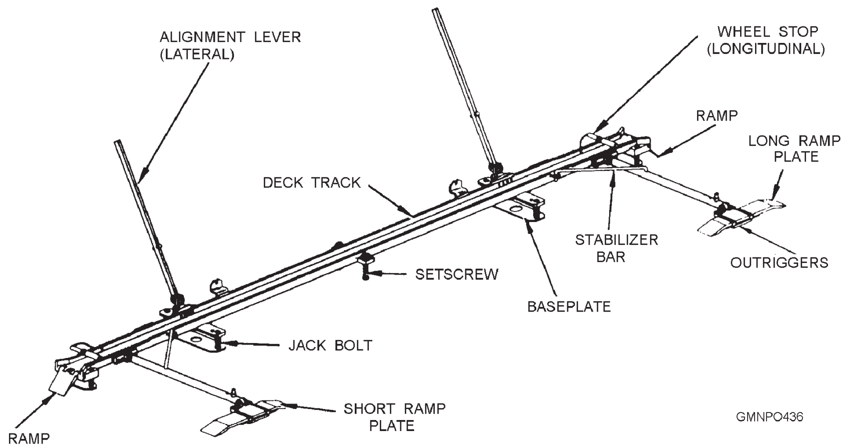

Figure 8-11.—AAW missile receiver beam.

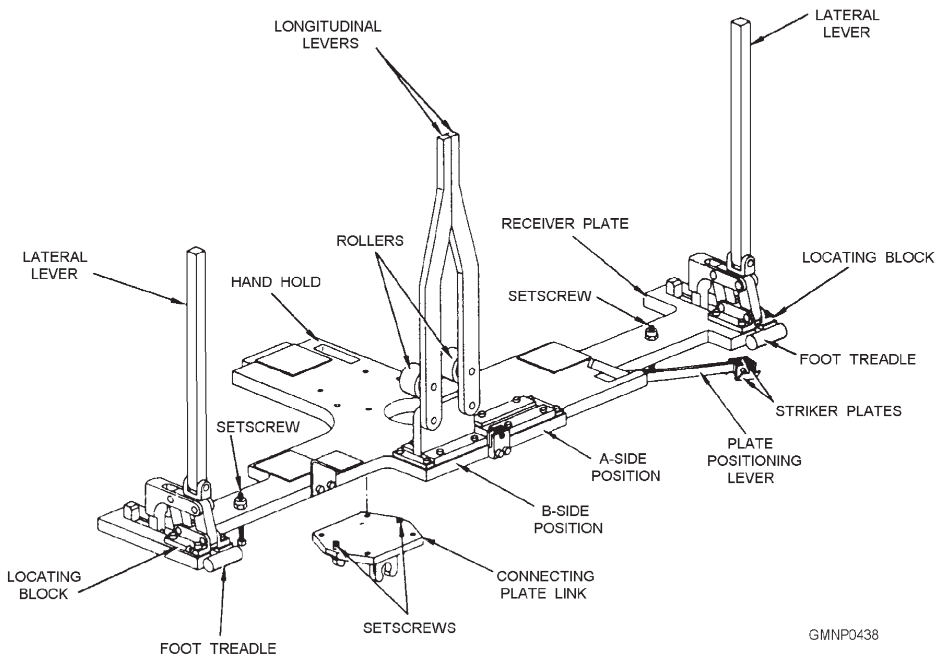

Figure 8-12.—ASW container receiver plate.

degree of floating movement to aid in missile shoe alignment.

When an ASROC missile arrives on board, special hand trucks are used to position the shipping container over the receiver plate. After the container is secured to the receiver plate, the top lid of the container is removed. The strikedown beam is then depressed to horizontal. The combined acts of extending the strongback and raising the receiver piston cause the upper shoes of the missile to engage the ASW shoe latches of the strongback. When the latches are engaged, the strongback is retracted. This action lifts the missile out of its container, and the receiver piston is then lowered. An offload operation is just the opposite.

Strikedown Onload Operations

An Mk 26 GMLS strikedown onload may be studied in three phases: preparations, on-deck operations, and below-deck operations. Many of the equipment actions do overlap. An entire onload sequence can be performed rather rapidly either in step or auto control. In our discussion, we will onload one AAW missile using the A-side of the GMLS.

SYSTEM PREPARATIONS.—The MCC operator performs the initial steps to ready the GMLS. After activating the control system, a missile-type designation is assigned to an empty hanger rail. The A-RSR/hoist motor is started, and the manual transfer valve is shifted to provide hydraulic fluid to the strikedown mechanism. The MCC operator selects either auto or step strikedown loading control and opens the marine hatch.

The deck control operator (DCO) establishes communications with the MCC operator. The strikedown control panel is turned ON. Deck personnel remove the protective cover from a receiver piston assembly (which one depends on the replenishing side of the ship).

The DCO raises the receiver to set up the AAW dolly deck track and receiver beam. After the handling equipment is installed, the receiver and beam are lowered. The system is then ready to receive the first missile.

ON-DECK OPERATIONS.—The transfer dolly arrives on deck and is pushed onto the AAW dolly deck track. The missile is aligned and secured over the receiver beam. The DCO operator raises the carrier from the magazine. After the strikedown beam reaches the strikedown level (raised position), the index drum is rotated 80° from center to the selected receiver position. The strikedown beam is then depressed to its horizontal position over the missile. Identification then takes place. The DCO visually identifies the missile as an AAW or ASW type. A missile identification switch on the panel is placed in the AAW/ASW MISSILE position. The strongback will extend its full distance in this case. The other two switch positions (fig. 8-9), the SSM MISSILE and OFF positions, limit strongback extend-distance to accommodate the larger diameter SSM round. Both positions are inactive at that time.

Ensuring the strongback shoe latches are retracted, the DCO extends the strongback to the missile. The receiver piston is raised to place the upper missile shoes in the shoe recesses of the strongback. Jogging the RAISE switch controls the amount of receiver travel. (About 3 l/2 inches of lift is required to seat the missile shoes.) On-deck personnel make final alignment adjustments using the various lever handles. The missile is shifted from the dolly to the strongback. The DCO closes the strongback shoe latches and retracts the loaded strongback to the strikedown beam.

The second phase of missile identification has just taken place. Proximity switches were activated when the forward and aft missile shoe latches engaged. For an AAW missile, a switch was activated to identify the AAW missile group. The AAW identification probe of the strikedown beam (similar to the identification probe at the RSR hoist station) was extended into the round to identify the AAW missile type. If an ASW missile was loaded, one switch would identify the round as an ASW type. Another switch would activate if the missile was a depth charge configuration. The purpose of strikedown beam identification (topside) is to generate control system orders. The RSR may then automatically index an empty hanger rail with the same missile type assignment to the strikedown position.

Back on deck, the DCO raises the loaded strikedown beam to vertical. The index drum is rotated to centerline and latched. The carrier is lowered into the magazine and stops at the intertransfer level. While the carrier is lowering, snubber wedges on the selected hanger rail unlatch. The snubbers open to receive the missile from the strikedown beam.

BELOW-DECK OPERATIONS.—When the carrier reaches the intertransfer level, the MCC operator assumes control. The AAW identification probe is retracted, and the index drum is rotated 60$ to the A-RSR hanger rail. The hanger rail load segments open to receive the missile shoes. The strongback and missile then extend outward.

When the missile engages the hanger rail, the load segments close around the missile shoes. The carrier lowers 6 inches to the carrier stowage level. Lowering the carrier and missile engages the missile shoe restraining latches. The strongback shoe latches open, and the strongback retracts to the strikedown beam. The index drum rotates the beam back to centerline. The snubbers close and the snubber wedges engage.

One missile onload has just been completed. If additional rounds are to be onloaded, the process starts over again when the DCO raises the carrier. If the onload is finished, personnel topside disconnect and stow the handling equipment. The MCC operator closes the marine hatch and returns the GMLS to normal.

Strikedown Offload and Intertransfer

A strikedown offload is a reverse sequence of onload operations. Intertransfer operations change the distribution pattern of the magazine load. Intertransfer uses a combination of onload and offload procedures performed solely below deck. The marine hatch remains closed, and the MCC operator controls all equipment functions. The operation may be accomplished in step or automatic control.

MK 41 VERTICAL LAUNCHING SYSTEM

The Mk 41 vertical launching system (VLS) strikedown equipment is housed in the 5-cell strikedown module Mk 3 Mod 0 (fig. 8-13). This

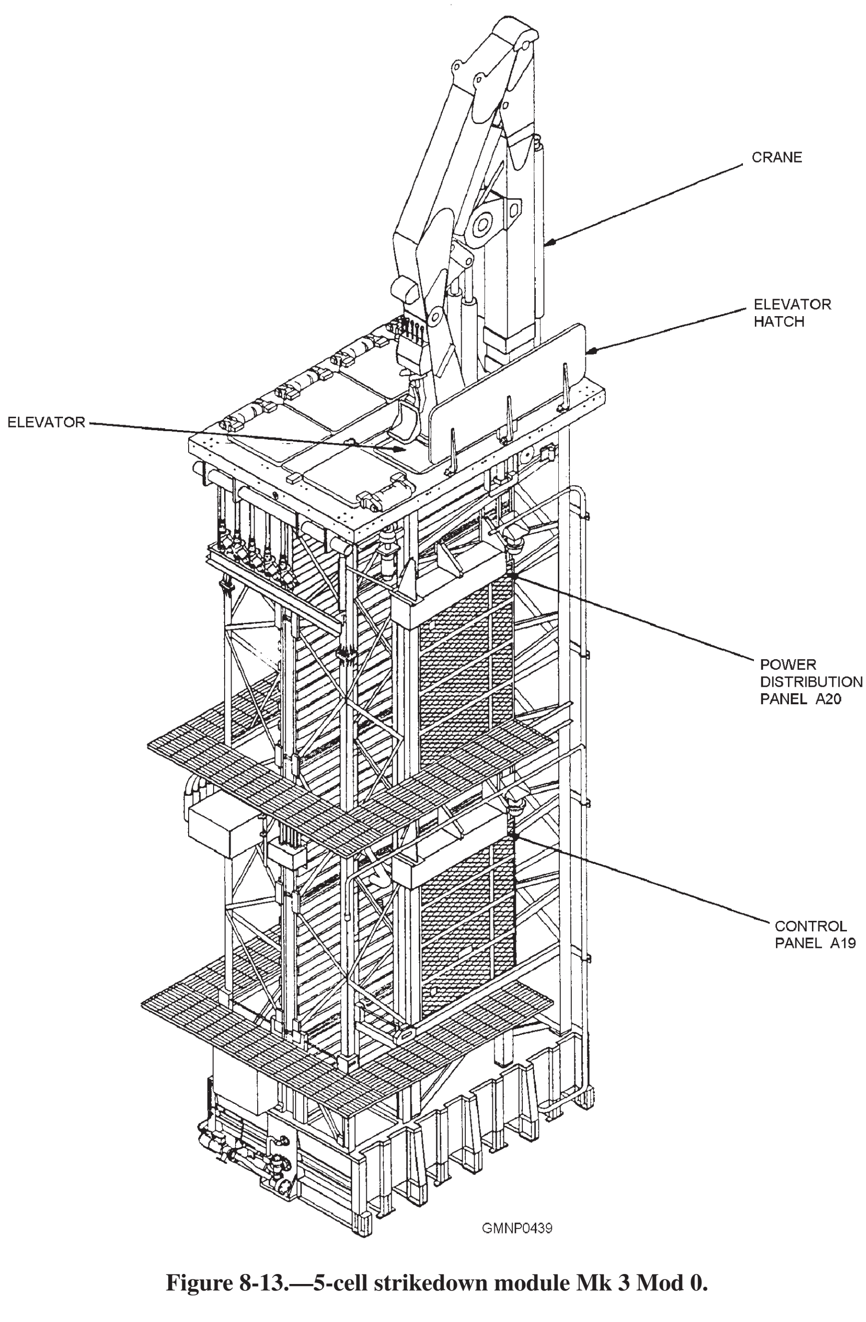

Figure 8-13.—5-cell strikedown module Mk 3 Mod 0.

strikedown equipment occupies cells 6, 7, and 8—the same cell space used in 8-cell modules Mk 1 Mod 0 and Mk 2 Mod 0 for missiles. The VLS strikedown equipment gives the VLS crew self-contained equipment that can be used to onload and offload missile canisters Mk 13 and Mk 15 and training canister Mk 19 into and out of the module cells. The strikedown equipment can also be used to remove any empty canisters and move other strikedown equipment as necessary.

Strikedown Equipment

The five-cell strikedown module consists of three subassemblies: the elevator hatch, elevator, and crane assemblies. When not in use, the hatch is closed and the elevator and crane are stored below deck until onload or offload operations.

ELEVATOR HATCH ASSEMBLY.—The elevator hatch assembly (fig. 8-14) is hinged to the deck platform. This assembly provides weather and ballistic protection for the strikedown crane, elevator, and launcher interior. The hatch is driven open or closed by the elevator hatch cylinder. When closed, the hatch is secured by six hatch dogs. The hatch dogs apply pressure to a watertight seal. The dogs are linked together and actuated by two chains, which are connected to, and operated by, the hatch dog/undog cylinder. Two directional control valves, located below the hatch on the walkway side (fig. 8-15), direct the flow of hydraulic fluid to the hatch dog/undog cylinder and the open/close hatch cylinder. The valves can be actuated manually in an emergency. The hatch operation is controlled by toggle switches located on the control panel A19.

ELEVATOR ASSEMBLY.—The elevator assembly Mk 2 Mod 0 shown in figure 8-15 consists of the support structure, elevator platform assembly, control panel A19, and power distribution panel A20. These parts work together to raise and lower the elevator assembly.

The support structure forms a shaft on which the elevator platform assembly travels. The shaft has lock bar sockets and guide rails that interface the platform with sensor switches on the support structure; these switches indicates the position of the platform. An alarm bell, mounted on the upper part of the support structure, sounds when the hatch or platform is in motion. An eight-section metal safety screen prevents personnel from falling into the elevator shaft and the moving platform. If the powered hydraulic pump fails, a manual hydraulic pump (fastened to the lower support structure) can be used only to dog/undog and open/close the elevator hatch.

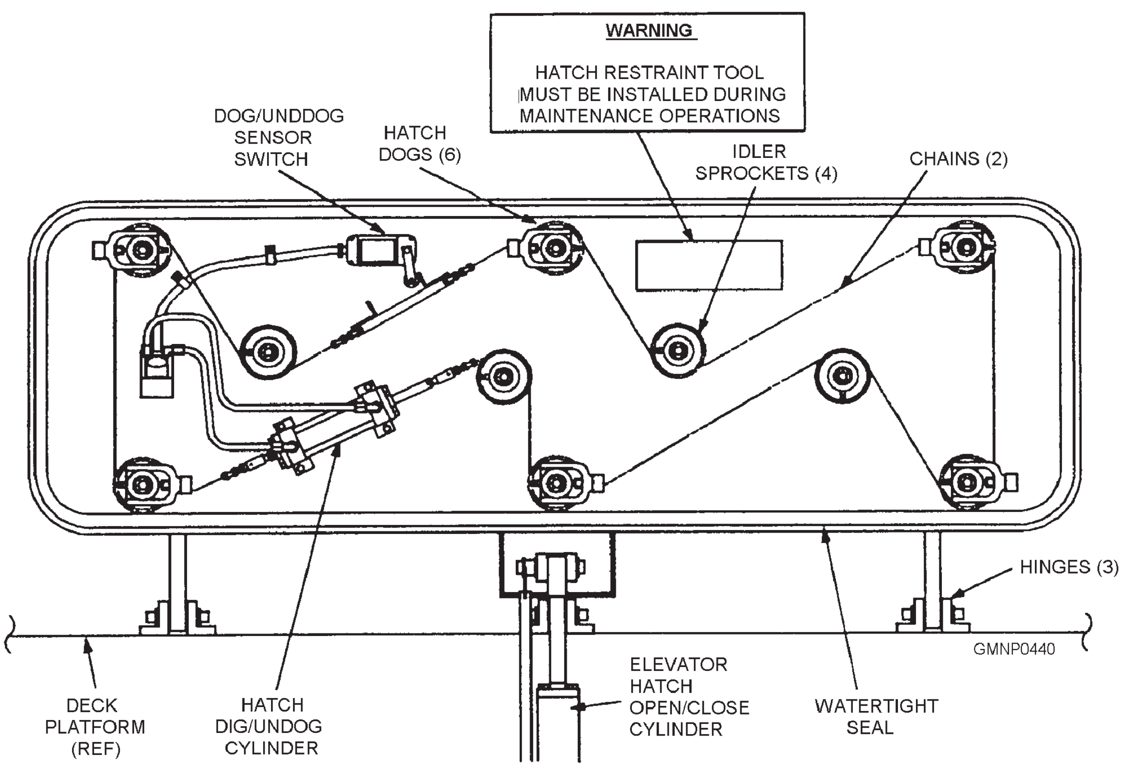

Figure 8-14.—Elevator hatch in OPEN position.

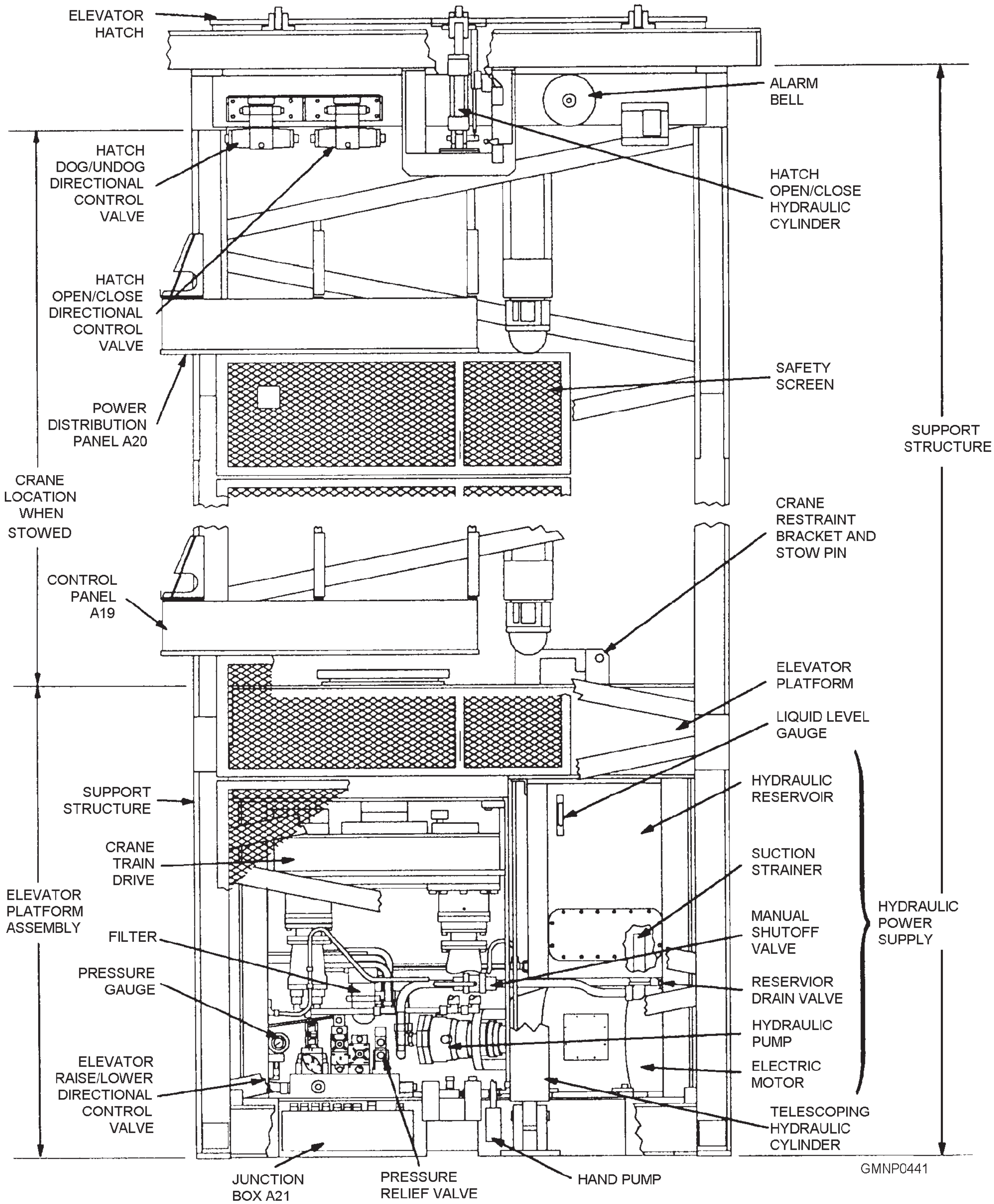

Figure 8-15.—Elevator assembly Mk 2 Mod 0.

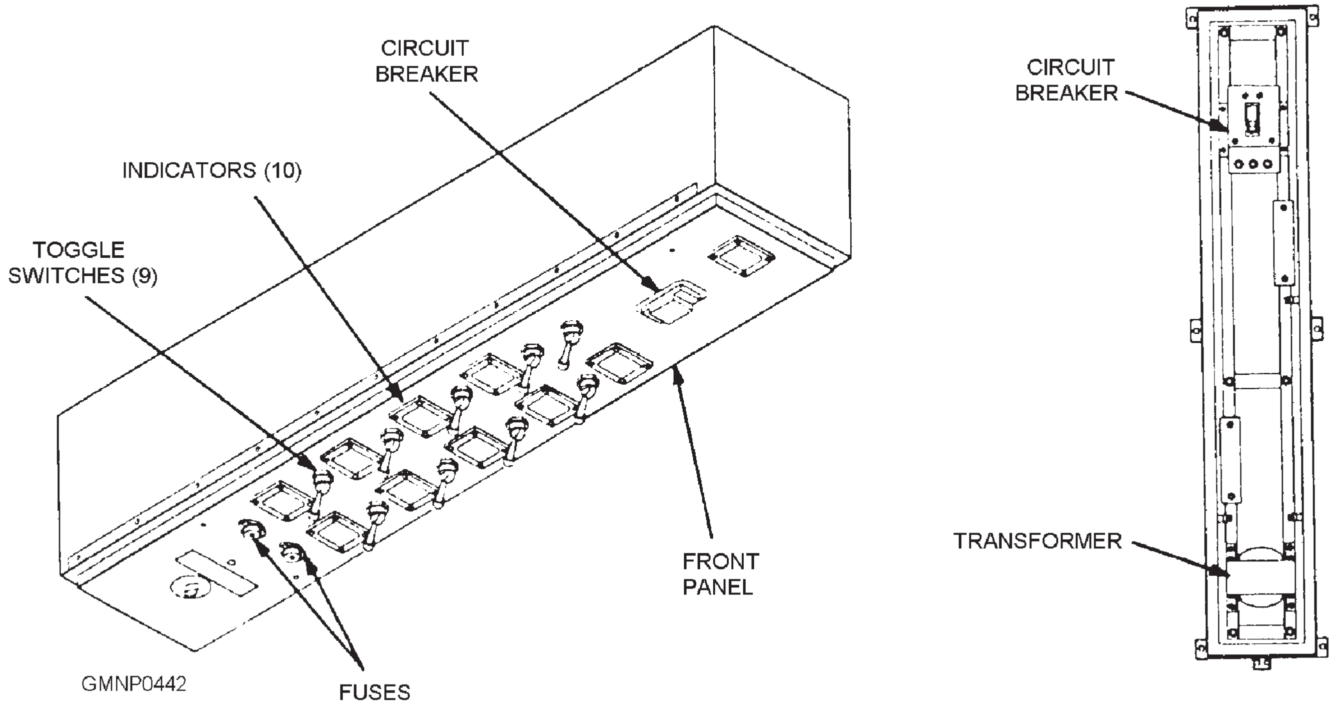

Figure 8-16.—Control panel A19.

The elevator platform serves as a base for the strikedown crane. The platform, which is rectangular in shape, is mounted on a three-stage telescoping hydraulic cylinder. The cylinder raises and lowers the platform. The platform can be moved only when the crane is stowed. An emergency system, consisting of a spring set and two knurled rollers, stops the downward motion of the elevator if hydraulic pressure falls below 200 psi.

The control panel A19 (fig. 8-16) is a watertight cabinet mounted on the elevator support structure just below the upper walkway, as shown in figure 8-15. The A19 control panel lever-lock toggle switches control the motor hydraulic power start-up, elevator hatch, lock bars, and elevator. These switches, except MOTOR-START and MOTOR-STOP, must be actuated and held until the desired function is complete. Except for MOTOR-START and MOTOR-STOP, the

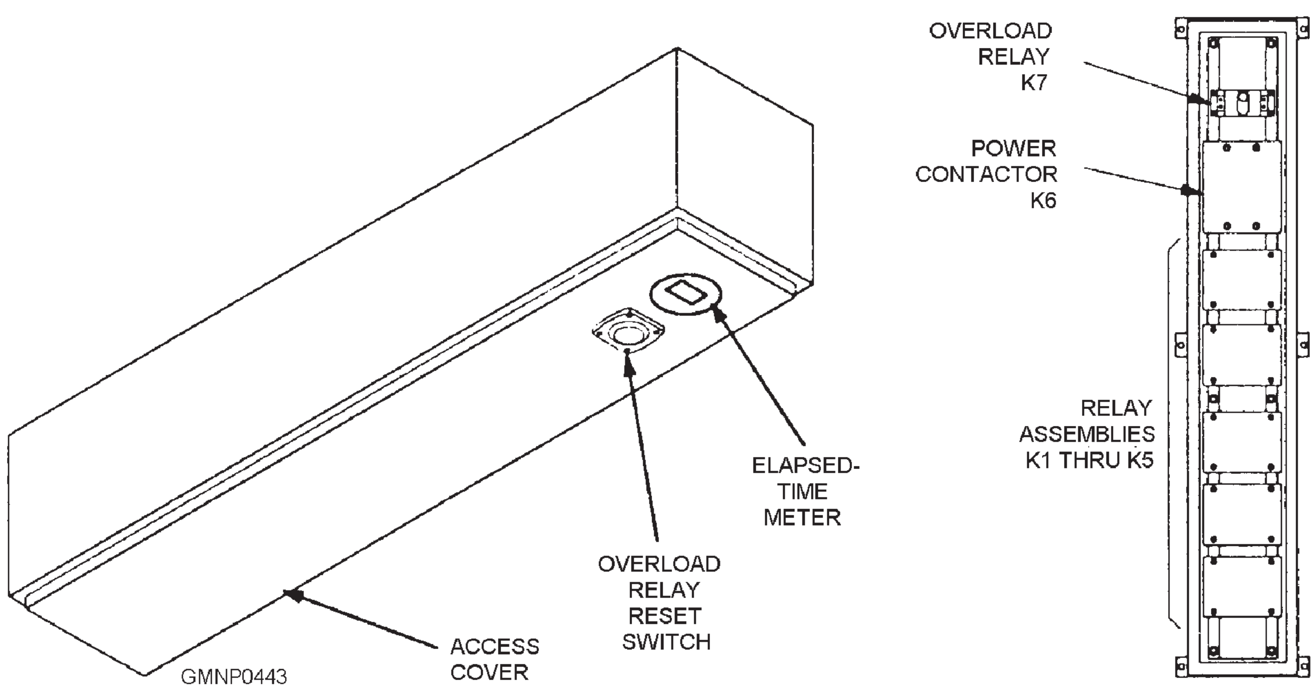

Figure 8-17.—Power distribution panel A20.

operation can be stopped any time by the release of the toggle switch.

The power distribution panel (PDP) A20 (fig. 8-17) routes the 440-VAC, 60-Hz, three-phase power through a three-phase power contactor to the 30-hp electric motor of the hydraulic power supply. The cabinet is watertight and mounted near the top of the elevator support structure, as shown in figure 8-15. The overload relay reset switch and elapsed time meter (that records component in-service time for the elevator) are located on the access cover.

CRANE ASSEMBLY.—The Mk 1 Mod 0 strikedown crane (fig. 8-18) is a hydraulically powered, knuckled-type crane. The crane mast is bolted to the

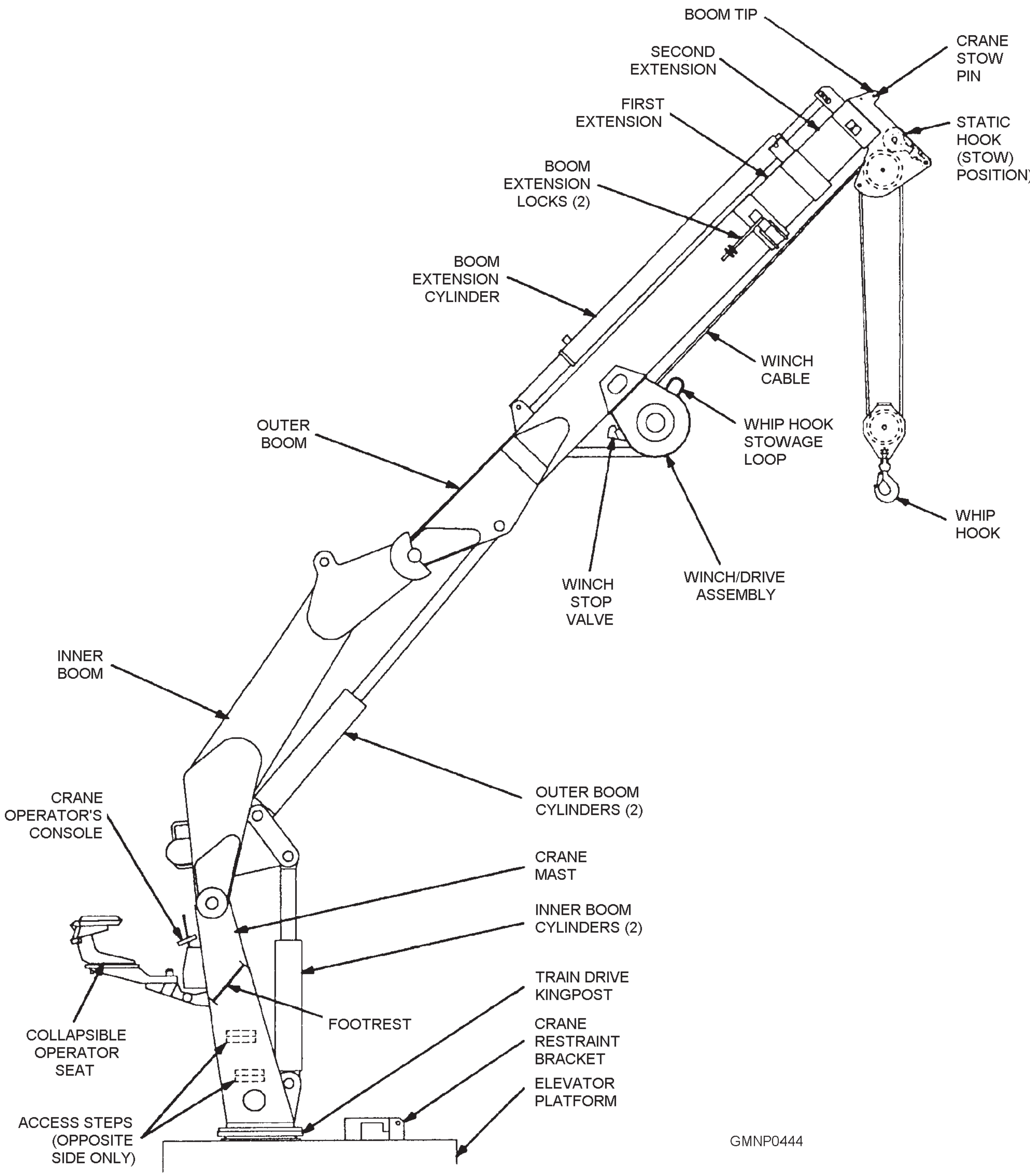

Figure 8-18.—VLS strikedown crane Mk 1 Mod 0 in operating configuration.

elevator platform through the drive king post. The crane mast contains the crane operator's console, collapsible operator seat, footrests, and access steps. The elevator assembly supplies the electric power for the crane indicator night lights and the hydraulic power that drives the crane.

The crane has an inner and outer boom connected in series to the upper end of the mast by pivot points (referred to as knuckles). Two parallel hydraulic cylinders pivot the inner boom at the mast, and two others pivot the outer boom at the inner boom. A duplex-type hydraulic cylinder attached to the outer boom extends and retracts the two boom extensions.

The crane contains a static hook (on the bottom tip) that is secured with a stowage pin when not in use. A whip hook, on a pulley block, raises and lowers as the winch pays out or reels in the winch cable. The winch/drive assembly is hydraulically driven.

The crane operator's console contains the directional control levers (fig. 8-19) used to train the crane mast, raise and lower the inner boom, raise and lower the outer boom, extend and retract the boom extensions, and raise and lower the whip hook. Four visual indicators are located near the controls. The train bearing, inner boom elevation angle, and boom extension indicators enable the operator to position the boom over any selected cell. The temperature gauge allows the operator to monitor hydraulic fluid temperatures during crane or elevator operations.

Strikedown Operations

All strikedown operations contribute to the safe loading or offloading of missile canisters from the VLS. These operations require a well-trained, competent crew that strictly adheres to basic strikedown operations.

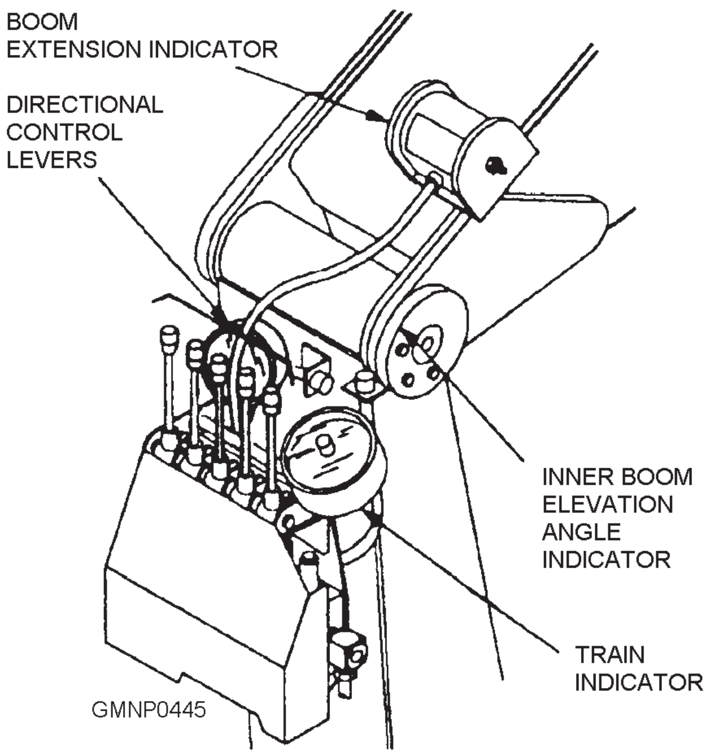

Figure 8-19.—Crane operating controls.

Before any strikedown operation, the deck supervisor reviews the planned operations with the crew and delegates specific assignments. During strikedown operations, it is paramount that the crew maintain constant communication. All members of the strikedown crew, with the exception of the deck crew, must be personnel qualification system (PQS) certified and have a naval enlisted classification (code) (NEC) of 0981.

Strikedown Procedures

Because of the complexity of the procedures for strikedown operations of the VLS, they cannot be covered here. These procedures are described in detail in NAVSEA Technical Manual SW394-AF-MMO-050/VLS, revision 2, *Vertical Launching System Mk 41 Mods 0/1/2 Strikedown Equipment*.

FIRE SUPPRESSION SYSTEMS

LEARNING OBJECTIVES: Explain the purpose and basic functions of fire suppression systems used in GMLSs.

GMLS fire suppression systems are designated as auxiliary equipments within the launching system. They protect the ship and its personnel from hazardous conditions resulting from fires or the high temperatures of fires. The text discusses three basic classes of fire suppression systems used in the GMLS community:

1. Carbon dioxide (CO_2) systems
2. Water injection systems
3. Dry-type sprinkler systems

CO_2 systems are used primarily to combat electrical fires. Fixed or installed CO_2 systems normally protect the unmanned GMLS areas, such as magazines and some launchers. Portable systems (you and a 15-pound CO_2 extinguisher) are normally used to protect the manned GMLS areas, such as launcher control rooms.

Water injection systems are designed to direct a continuous stream of water into the exhaust nozzle of a rocket motor. Should the rocket motor accidentally ignite in the magazine, the stream of water will control the burning reaction of the propellant. The water will also cool the missile and the surrounding area. It MAY EVEN extinguish the burning rocket motor, but not necessarily. Water injection systems are also known as booster suppression or quenching systems.

Sprinkler systems are designed to spray water onto the missiles in magazine stowage and handling areas of a GMLS. Sprinkler systems aid in extinguishing fires. They also cool the missiles below the temperatures that could start rocket motor ignition or warhead detonation.

In covering the various GMLS fire suppression systems, we will deviate slightly from the sequence we have followed so far. A typical or representative system will be presented. Any important differences or unique features of individual GMLSs will be noted. Mainly, component location and numbers are the greatest difference.

A TYPICAL CARBON DIOXIDE SYSTEM

A typical GMLS carbon dioxide (CO_2) system is permanently installed (fixed) in the missile magazine area. The system is designed to detect an excessive temperature buildup and activate automatically. Once the system is activated, the entire space is flooded with a large volume of CO_2 extinguishing agent. The system may also be activated manually from either a local or remote control station.

Physical and Functional Description

The primary pneumatic-mechanical components of a simple CO_2 system include the thermopneumatic control elements and supply cylinders. The supply cylinders are equipped with control and discharge heads. The system also has other associated valves and alarm switches. Many of these components are located just outside the magazine structure. The control devices and CO_2 discharge nozzles are inside. They are strategically placed near fire-prone equipments (electric motors, connection boxes, slip rings, and so on).

HEAT-SENSING DEVICES.—Heat-sensing devices (HSDs) were formerly designated thermosylphon units. HSDs are the detecting units of the system (fig. 8-20). They are designed to develop a pneumatic pressure signal when space temperature increases to a preset activating point. The rate of rise in space temperature may be rapid or slow.

The HSD consists of a spring-loaded, rubber bellows housed in a mesh-style cage. The bellows is held in an extended or expanded position against a compressed spring by a fusible element. HSDs are mounted above the area they monitor. They connect to the control head of the CO_2 supply cylinder by a pneumatic transmission-line network.

In the event of an actual fire or explosion, a rapid rise in space temperature is experienced. The heat generated by the mishap is conducted to the air inside the HSD bellows. The air inside the bellows quickly expands and increases in pressure. This pressure "signal" is transmitted to the control head of the cylinder. The pressure-sensitive head is tripped, and the system is activated.

In the event of a smoldering type of fire or a heat buildup resulting from a fire in an adjacent compartment, a slow rise in space temperature is experienced. In this case, the air inside the HSD bellows expands (as before). However, its reaction is not quick enough to trip and activate the system. For this reason a fusible element is used.

HSDs are designed with a fusible link as the melting element. The link is made of a low-melting-point metal compound similar to solder. When

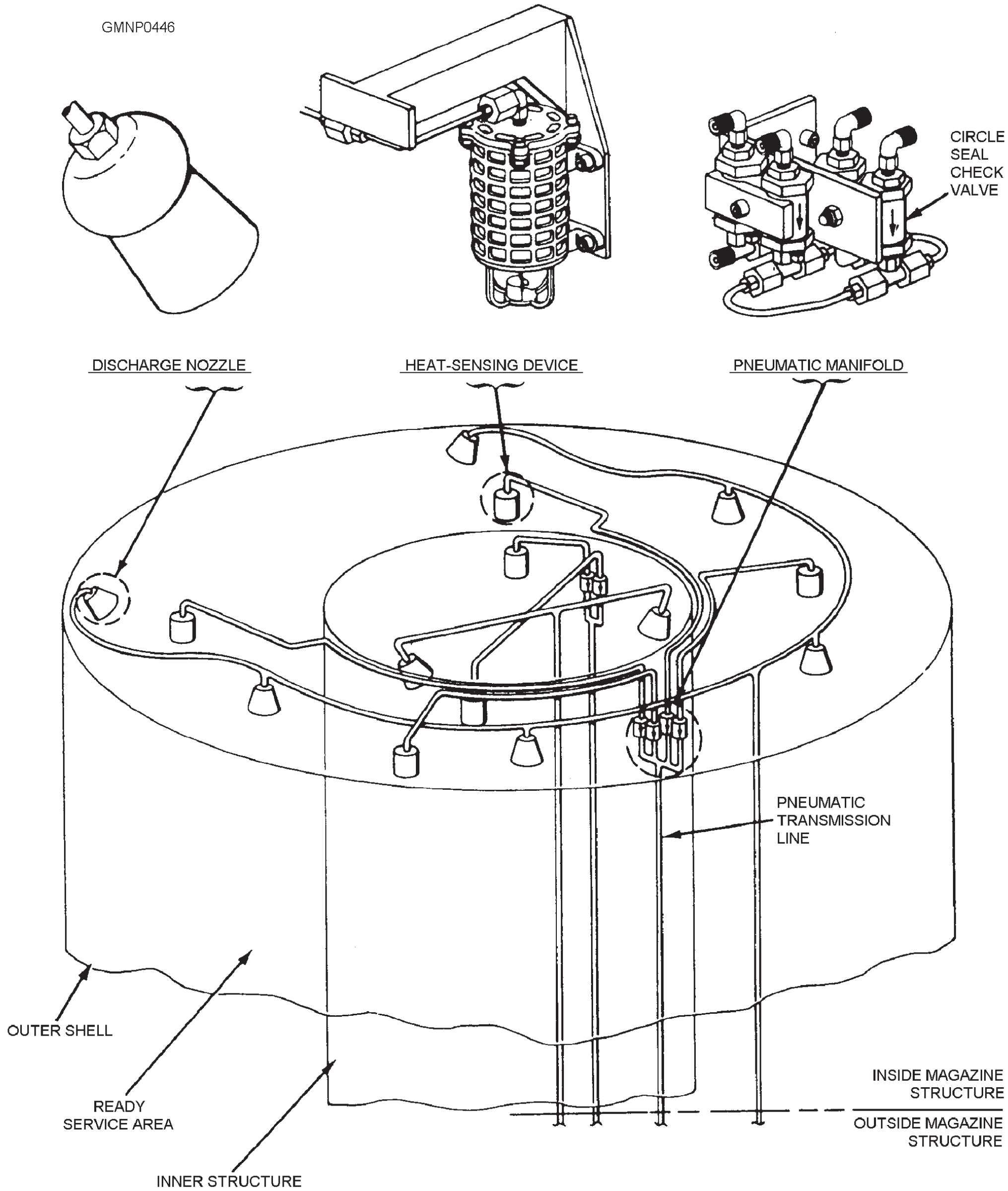

Figure 8-20.—Components of a CO_2 system; inside magazine structure.

a certain temperature is reached, the compound starts to melt.

In a GMLS CO_2 system, the fusible link is designed to melt at about 160°F ±3°). When the fusible element melts, the compressed spring around the bellows is released and allowed to expand. This action causes the bellows to collapse. The sudden compression of the HSD bellows creates a pneumatic pressure impulse signal. The magnitude of this air signal is measured in ounces per square inch (osi). The pressure impulse trips the control head and activates the system.

Transmission Lines.—Transmission lines connect the HSDs to the control head. The lines are 1/8-inch OD (outside diameter) by 0.088-inch ID (inside diameter) rockbestos-covered, seamless copper tubing. Quite a few rules pertain to the correct material and installation requirements associated with these lines. Refer to *Technical Manual for Magazine Sprinkler Systems* for guidance when repairing or replacing transmission lines. (Although this manual is the master reference for sprinkler systems, much of its information also pertains to CO_2 system requirements.)

Circle Seal Check Valves.—The circle seal check valve (shown in fig. 8-20) is a brass, spring-loaded check valve. It closes against a rapid change of air pressure in one direction and opens when air pressure is applied in the other direction. One circle seal check valve is installed in each transmission line leading from an HSD. The valve is installed with its directional arrow (stamped into the body) pointing toward the control head.

The check valve prevents the rapid increase of air pressure created by one HSD (such as when its bellows collapse) from pressurizing the other HSDs. The full air-pressure signal is then ported directly to the control head. This action ensures positive system activation.

A vent is installed in the body of the check valve. The vent permits a slow backflow of air to bypass the main check valve element. This venting equalizes air pressure within the system in response to normal changes in ambient (surrounding) temperature.

SUPPLY CYLINDERS.—GMLS fixed CO_2 systems usually have at least two supply cylinders. Each cylinder has a 50-pound CO_2 capacity and weighs 165 pounds when fully charged. It contains liquid carbon dioxide under a pressure of 850 psi at 70°F. Each cylinder of the system has a discharge head and a cylinder valve. At least one of the cylinders will also have a pneumatic control head. The other cylinder(s) will be in tandem with the main control cylinder(s). See figure 8-21.

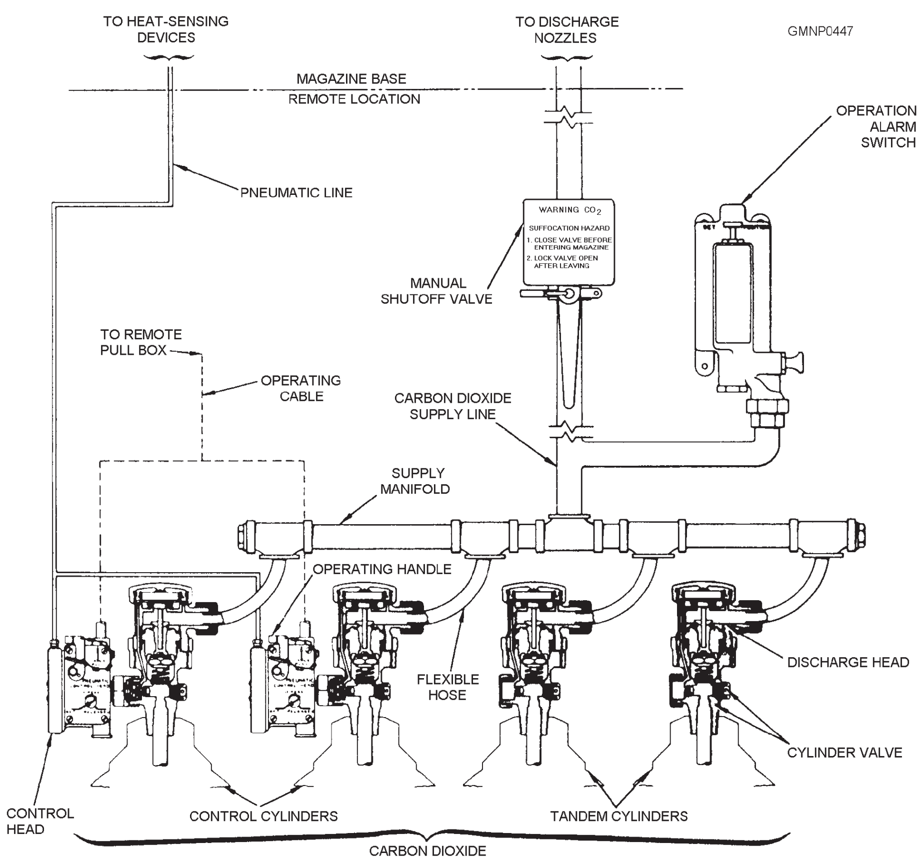

Figure 8-21.—Components of a CO_2 system; outside magazine structure.

Pneumatic Control Head.—A pneumatic control head (shown in fig. 8-21) reacts to HSD pressure signals or to manual operating levers. The control head is tripped to open the discharge head and cylinder valve, which release the liquid CO_2 from the cylinder. The control head consists of an air chamber with a diaphragm. The control head also has two plungers, safety locking pins, and a manual (local) operating lever.

The pressure chamber in the control head has an orifice that vents air pressure at a predetermined rate. When pressure in this chamber increases faster than it can be vented, the diaphragm expands. This movement trips a lever that releases a trigger mechanism. The trigger mechanism shifts the two plungers. Shifting the plungers opens the pilot seat in the cylinder valve.

Cylinder Valve and Discharge Head.—The cylinder valve and discharge head are shown in figure 8-22. Together, they block the escape of the liquid CO_2 from the cylinder until the control head is activated.

When the plungers from the "tripped" control head open the pilot seat, CO_2 flows into the chamber above the discharge head piston. The piston is shifted (down) against its spring. The ball check valves trap gas pressure in the upper chamber. This keeps the piston open (down) and ensures rapid and complete cylinder discharge. Shifting the piston opens the cylinder valve, allowing CO_2 to flow to the exhaust manifold and supply lines. (See fig. 8-21.)

DISCHARGE NOZZLES.—CO_2 discharge nozzles are installed so that their discharge blankets certain key electrical components. The nozzles are also located so that the entire area they serve is flooded with CO_2. The nozzle is a bell-shaped device (fig. 8-20) with an orifice at its discharge point. The orifice restricts the discharge of the CO_2 and creates an even flow from all system nozzles. The gaseous "snow" of CO_2 quickly extinguishes the fire.

MISCELLANEOUS COMPONENTS.—A manually operated shutoff valve is installed in the CO_2 discharge line between the supply cylinders and discharge nozzles. (See fig. 8-21.) The valve is physically located outside the magazine near its entrance. To avoid a CO_2 suffocation hazard, unlock the valve and close it before you enter the magazine. If the system should activate, the supply cylinders will release CO_2. However, the closed valve will stop the CO_2 so that you can keep breathing.

CO_2 pressure entering the supply line activates an operation alarm switch (fig. 8-21). Audible alarms and lights are turned on, signaling that the CO_2 system has activated. These warning devices are usually located right outside the magazine area and at the ship's damage control (DC) central room. The switch must be manually reset if activated. The alarm circuits may be maintenance-tested.

A remote control pull box allows personnel to release the pneumatic control head(s) manually. The

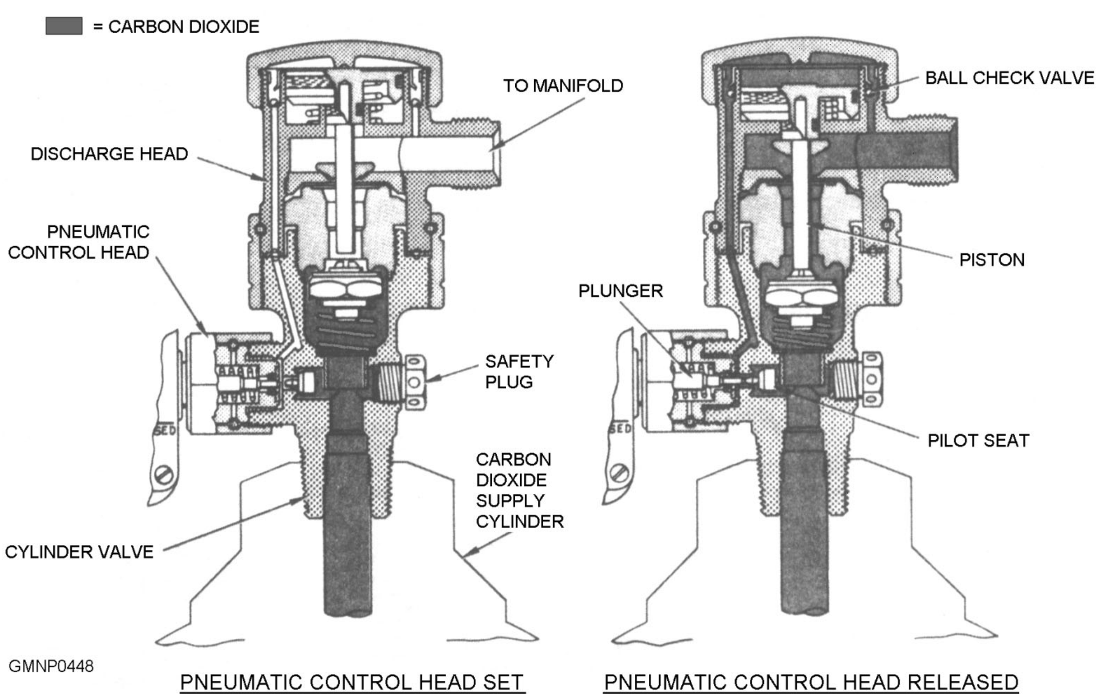

Figure 8-22.—Cylinder value and discharge head schematic.

pull box is located outside the magazine. It has a transparent, breakable shield and a pull handle. A wire cable is connected to the control head trigger mechanism. Breaking the glass and pulling the handle activates the system. The CO_2 system can also be activated locally. Manually removing a safety pin and tripping a lever on the pneumatic control head releases the CO_2.

Actual GMLS CO_2 Systems

Every GMLS has some type of CO_2 fire-fighting capability. Some GMLSs have a combination of fixed and portable CO_2 protection. Other GMLSs only have portable extinguishers available. System design and configuration sometimes restrict the installation of fixed CO_2 system hardware.

The Mk 26 GMLSs do not have a fixed CO_2 system. Portable extinguishers, readily accessible throughout key areas of the GMLSs, provide the protection.

The Mk 13 GMLSs do have fixed CO_2 systems in addition to portable extinguishers. The Mk 13 GMLSs have separate inner and outer magazine CO_2 systems (fig. 8-23). The inner system covers the center column or inner structure. The outer system floods the RSR area.

A TYPICAL WATER INJECTION SYSTEM

The general purpose of a water injection system has already been stated. In a static or ready condition, injection system piping places a charged supply of freshwater under each missile. Should a missile accidentally ignite, blast pressure will activate the system. Instantly, a pressurized stream of freshwater injects into the core of the rocket motor. When the limited supply of freshwater is depleted, salt water (from the fire main supply) is used to continue the operation.

Once the injection system is activated, it must be secured manually. Additionally, provisions must be

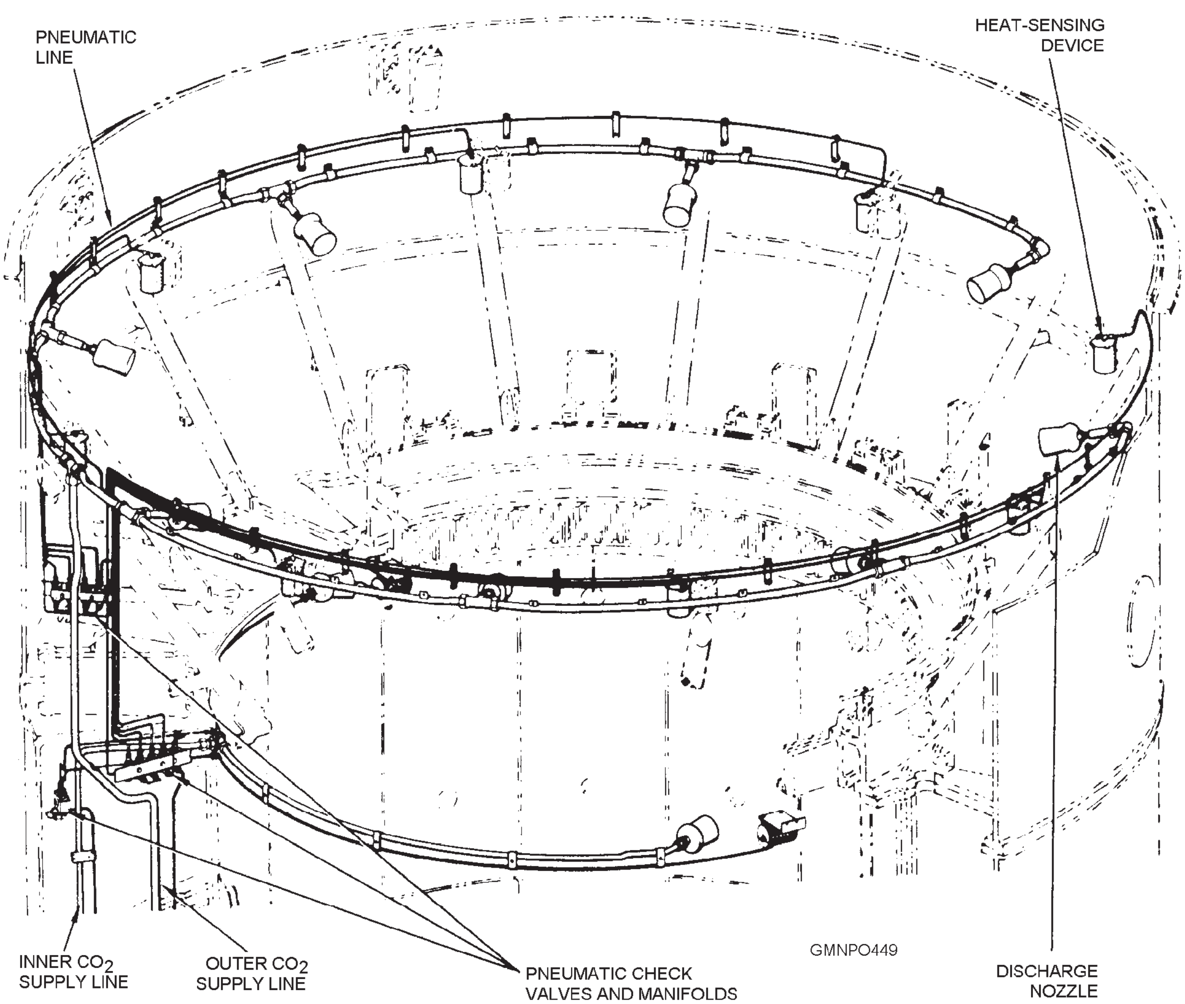

Figure 8-23.—Arrangement of inner and outer CO_2 systems.

made to remove and discharge the large quantity of water remaining in the magazine. That is normally accomplished by a magazine drainage system and an overboard eductor system.

Why use freshwater? Freshwater is used because it does not promote corrosion as quickly as salt water. Salt water can ruin the piping and valves of the system. Normally, an additive to the freshwater slows any corrosive action and helps seal minor leakage.

System Description

Many of the water injection system components are located outside the magazine area. They function to maintain the system in a ready state and supply the freshwater and salt water. The components inside the magazine distribute and activate the injection system. Refer to figure 8-24 for a schematic illustration of a typical water injection system.

EXTERNAL MAGAZINE COMPONENTS.— The compression tank of the injection system is usually located in a machinery room below or near the magazine. The tank is an enclosed structure, normally filled with freshwater to one half of its 125-gallon (approximate) capacity. The tank is then charged to 200 psi from a ship's HP air supply. The 200-psi freshwater pressure is transmitted throughout the injection piping network and remains in a static state under each missile.

A flow switch is installed in the outlet line of the tank. When the system does activate, freshwater flows through the switch. The switch actuates and energizes a variety of equipments. Examples include ship fire pumps, alarm circuits, and eductor systems.

A check valve is also installed in the outlet line of the tank. When open, it permits freshwater to flow to the water injector piping. When closed, it prevents salt water from flowing back into the compression tank.

Another hydraulically operated check valve, designated the main check valve, is shown in figure 8-24. It isolates the fire main supply from the injection system until the system activates. In a static state, the

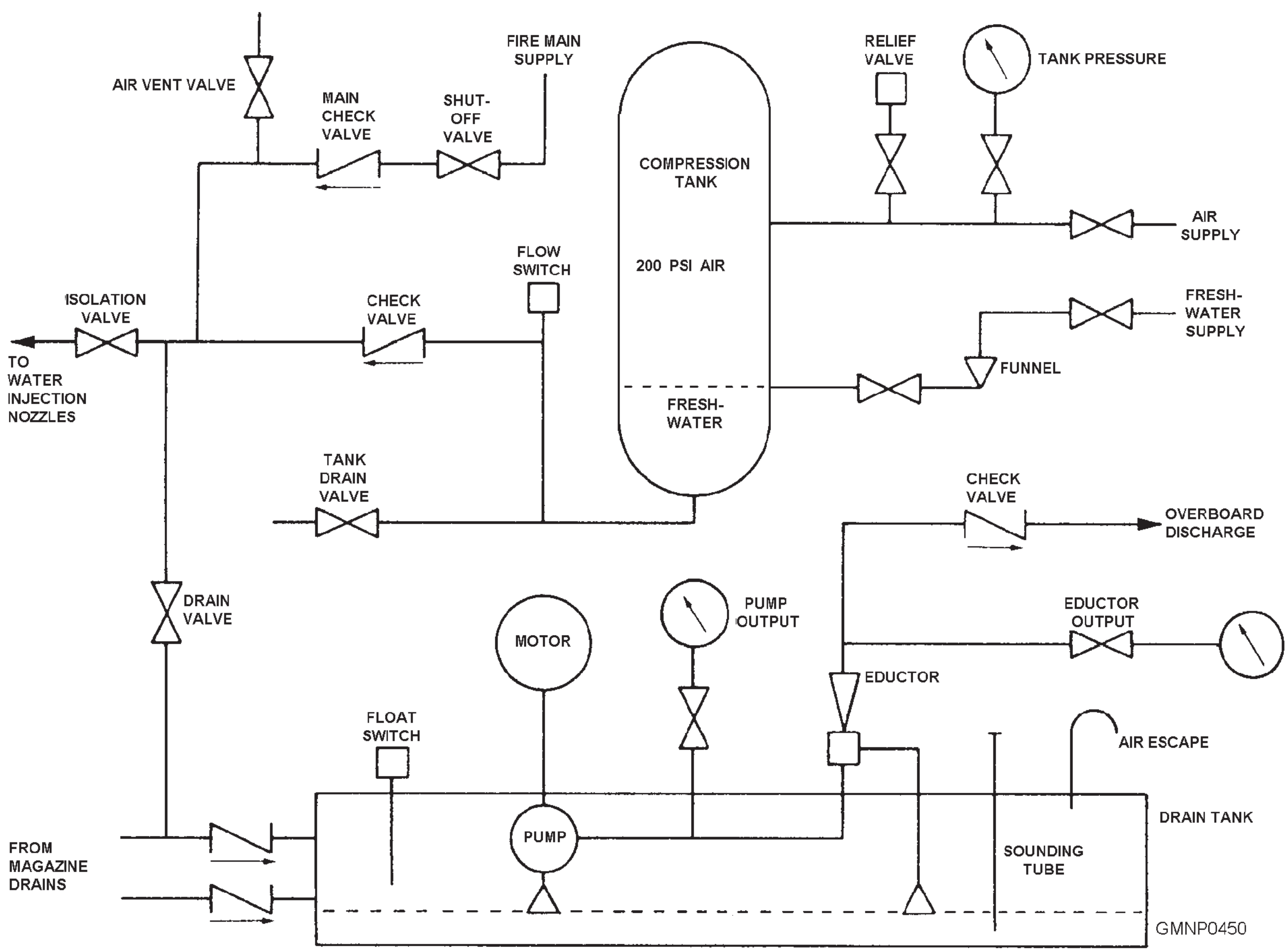

Figure 8-24.—A typical water injection system; these components are located outside the magazine.

200-psi freshwater supply keeps the valve closed against the ship's fire main supply. (Let us assume fire main supply pressure is rated at 70 psi. Actual fire main pressure varies among ships.) However, when the system does activate, the 200-psi freshwater pressure will decrease. As fire main pressure equals or exceeds freshwater pressure, the main check valve opens. Salt water flows to the piping network of the system. A manually operated shutoff valve above the main check valve must be closed to secure the system.

INTERNAL MAGAZINE COMPONENTS.—The injection system piping network distributes injection water around the magazine base area. At every position a missile can come to rest, a standpipe is threaded into the supply lines. Attached to the top of the standpipe is a water injection (detector) nozzle. The unit is just a few inches below the tail cone of the rocket motor.

The main component parts of a detector nozzle (fig. 8-25) include a closure piston and an actuation piston. Three lock balls and a gold-wire spring pin connect the two pistons. The lock balls (l/4-inch ball bearings) are forced outward by the actuation piston. They serve to hold the closure piston in place against the 200-psi freshwater supply.

The actuation piston is held in place by the gold-wire spring pin. A force of approximately 16 pounds is required to break (or bend) the pin. Should a missile accidentally ignite, the pressure created by rocket motor exhaust acts on the top of the actuation piston. The piston is forced downward and breaks the pin. The lock balls drop into the throat of the nozzle and release the closure piston. The 200-psi freshwater pressure forces the closure piston upward to activate the injection system.

SYSTEM OPERATION.—Now that the injection system is activated, the other components begin to function. As the freshwater continues to shoot out the detector nozzle, the flow switch actuates. Freshwater pressure decreases and, in a matter of seconds, the main check valve opens. The system continues to operate, discharging the fire main supply from the (one) activated nozzle. When the emergency is over, personnel turn off the fire main supply to secure the system and replace the detector nozzle. The system is then flushed, refilled, and charged.

A word of caution worth remembering—Use extreme care when working around a water injection nozzle. The gold-wire spring pin is sensitive. A dropped tool or a misplaced foot can result in a tremendous surprise!

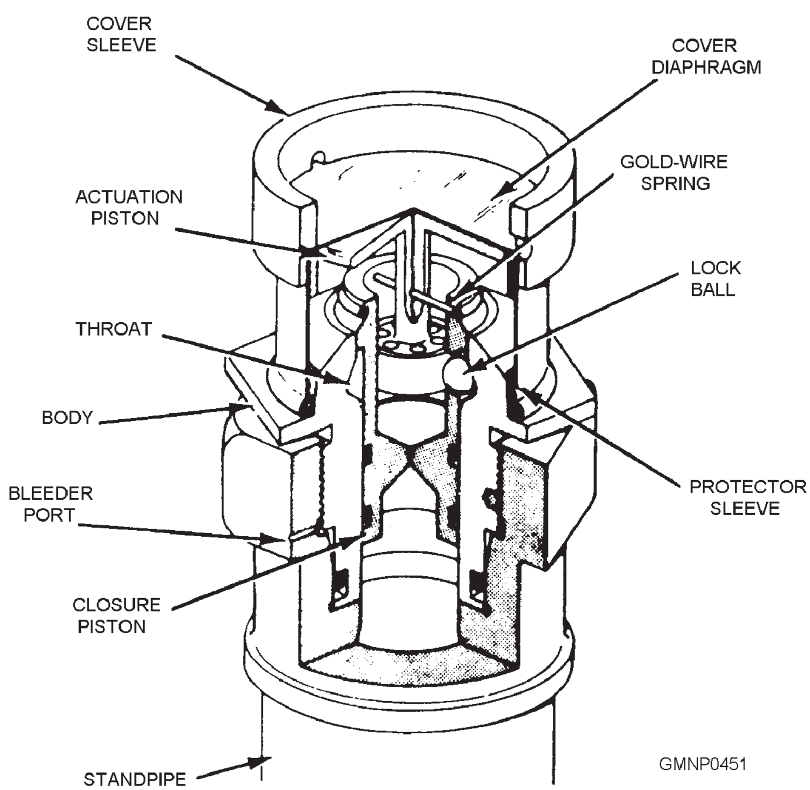

Figure 8-25.—Water injector (detector nozzle).

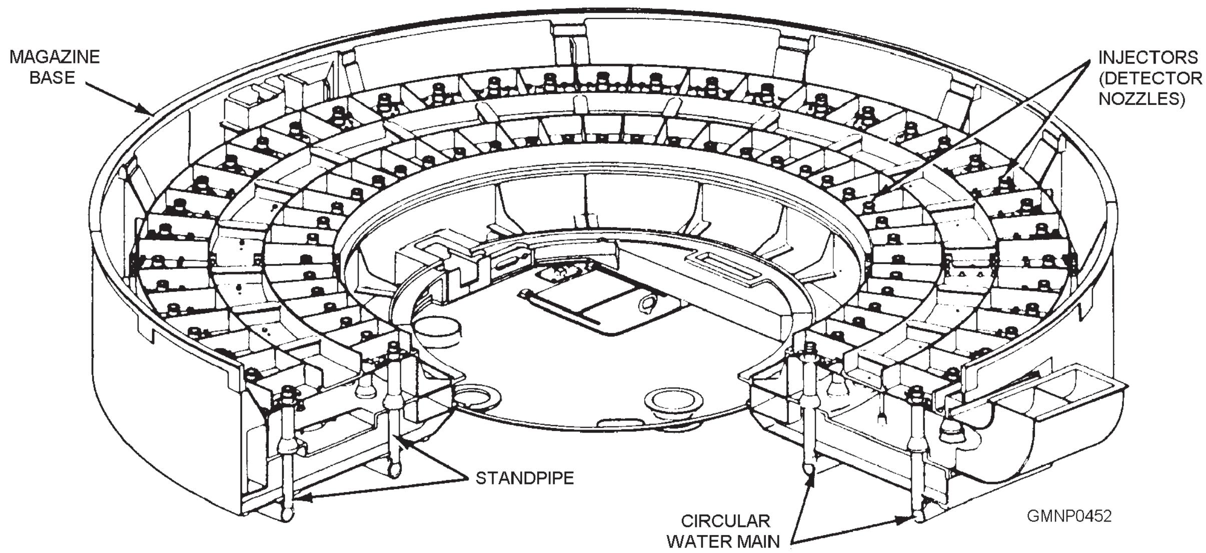

Figure 8-26.—Mk 13 GMLS magazine base; injection system arrangement inside magazine area.

Actual GMLS Water Injection Systems

All GMLSs have a water injection system. Each system operates on the same principle. Only the physical location and number of components differ.

The Mk 13 GMLSs (fig. 8-26) have a total of 96 detector nozzles (48 on the inner ring and 48 on the outer ring). Since the Mk 13 GMLS RSR rotates, the RSR cells (16 inner and 24 outer) can be indexed and stopped at over 96 different positions. The Mk 26 GMLS has one detector nozzle at each RSR hanger rail position. The Mk 41 VLS has a deluge system for each cell canister, which floods the canister during rocket motor ignition without the missile leaving the canister.

The Mk 13 GMLSs use a special valve in their water injection systems. It is called a restart valve. In the typical water injection system schematic (fig. 8-24), this valve would replace the manual shutoff valve above the main check valve. The restart valve may be operated manually or by a remote-controlled solenoid. The solenoid is actuated by a switch located inside the launcher control room.

Initially, the injection system must still be activated automatically. However, the restart valve may be used to secure the system. It can also be used to reactivate (restart) the system in an emergency situation (such as a flashback).

A special feature of the Mk 26 GMLS is that a sensing line connects the water injection system to the sprinkler system (fig. 8-27). Should a rocket motor ignite, the detector nozzle activates the injection system. Additionally, the blast pressure pushes the blow-in plate down, causing it to fall into the plenum port of the RSR station. Loss of a blow-in plate releases the drop-away plunger of a sprinkler-actuating valve assembly. Water pressure in the sensor line decreases and starts zone sprinkling. The operation is unique to the Mk 26 GMLS.

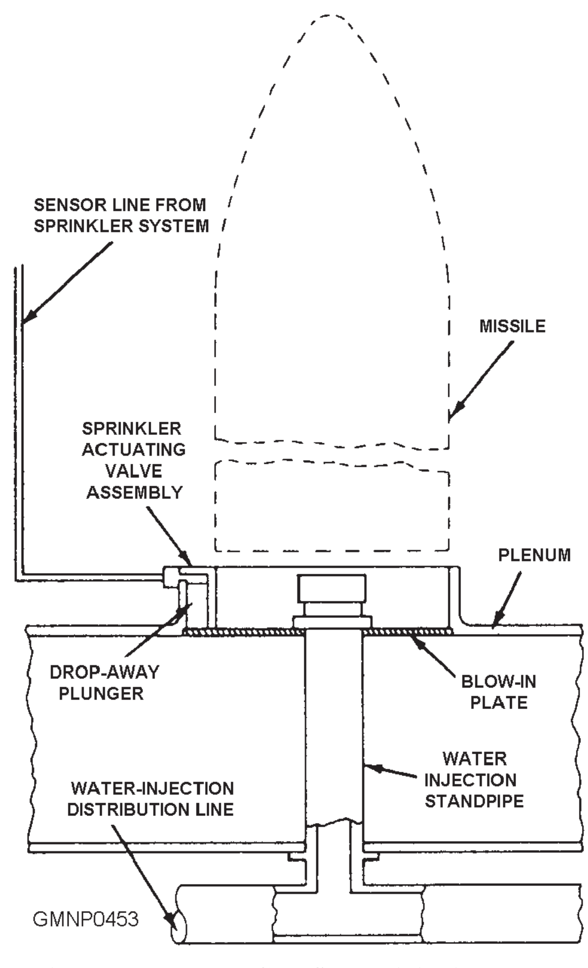

Figure 8-27.—Mk 26 GMLS water injection system.

DRY-TYPE SPRINKLER SYSTEMS

A dry-type sprinkler system is one in which the piping from the outlet side of the main sprinkler control valve up to the sprinkler heads contains no water in a normal or ready state. This piping remains "dry" until the system is activated.

The sprinkler system may be activated automatically or manually. A thermopneumatic system, using HSDs, performs the automatic function. Manual control valves, located at separate local and remote control stations, are used to activate the system manually.

Once the system is activated, it must be secured manually. System design permits it to be activated at one station and be secured from another station.

The Mk 13 GMLS and Mk 41 VLS have dry-type magazine sprinkler systems. A dry-type sprinkler system can be divided into four main equipment areas:

1. Automatic control system
2. Hydraulic control system
3. Main sprinkler control valve
4. Sprinkler alarm system

Figure 8-28 is a general schematic arrangement of the major sprinkler components. Take a moment to

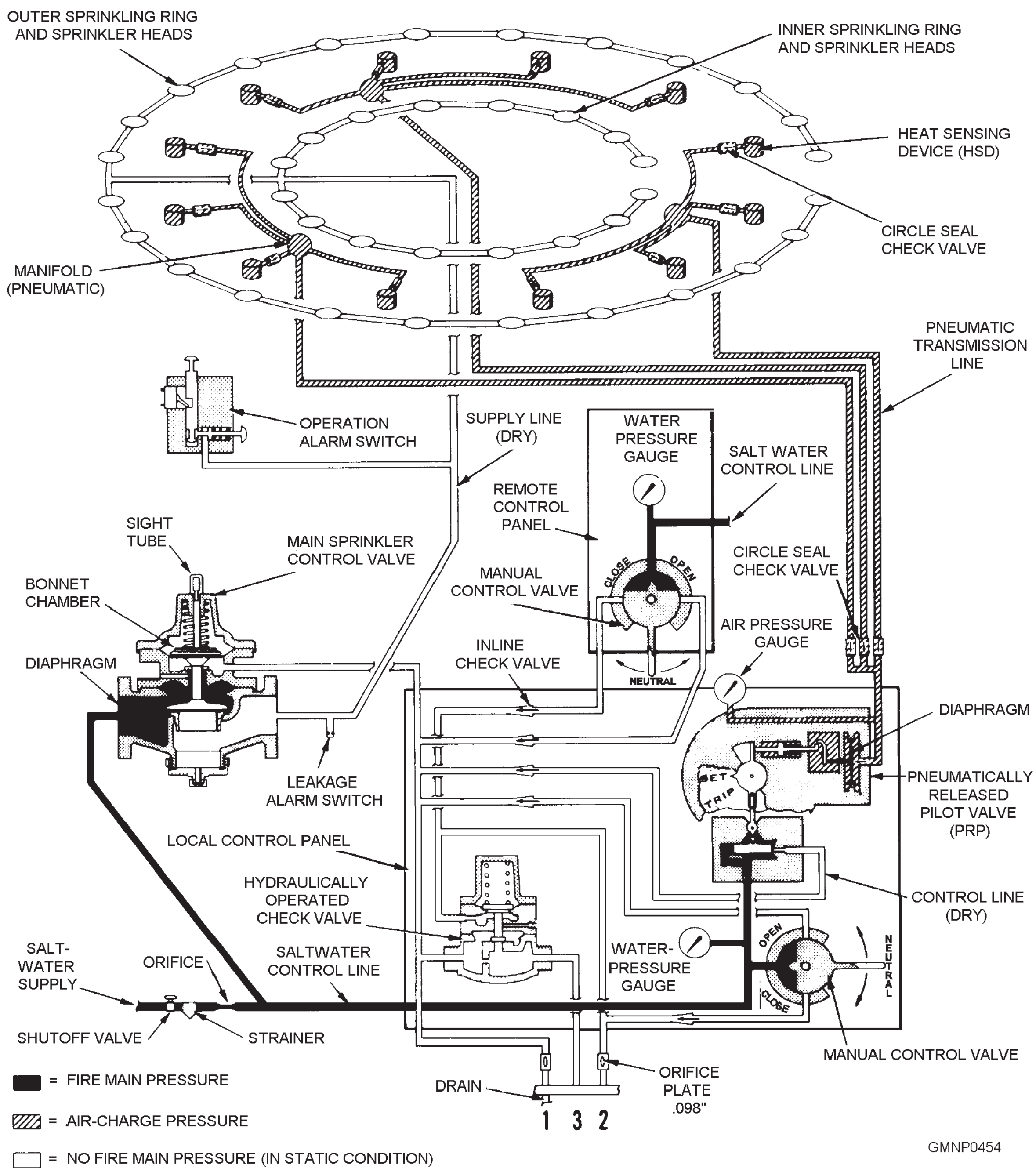

Figure 8-28.—Dry-type sprinkler system schematic; in static condition.

study it, as we will refer to it frequently. Locate the four equipment areas.

Automatic Control System

The automatic or thermopneumatic control system used on this sprinkler system is similar to that of a CO_2 system. The fusible link of the sprinkler HSDs (fig. 8-29) melts at 160°F (æ3°) and functions the same way as that in the CO_2 system.

Each HSD will also have its own circle seal check valve. Groups of HSDs can be connected to a common manifold. Each manifold will also have its own vented check valve. Transmission line tubing is the l/8-inch OD rockbestos style.

PNEUMATICALLY RELEASED PILOT VALVE.—The pneumatically released pilot (PRP) valve (fig. 8-30) is the main component of the hydraulic control system. It is shock-mounted to the local control panel inside the magazine or RSR. The PRP valve, in response to the pneumatic pressure signal from one or more HSDs, starts automatic sprinkler activation.

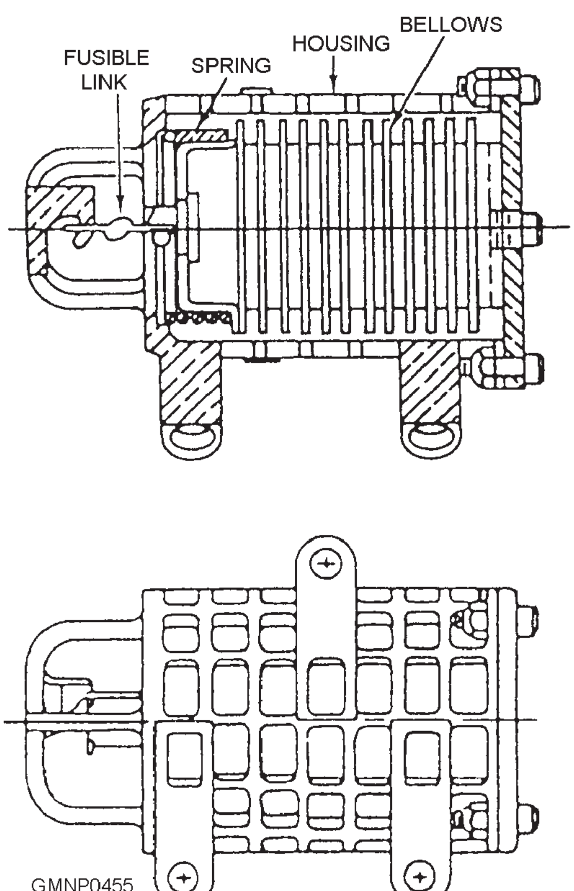

Figure 8-29.—Heat-sensing device (HSD).

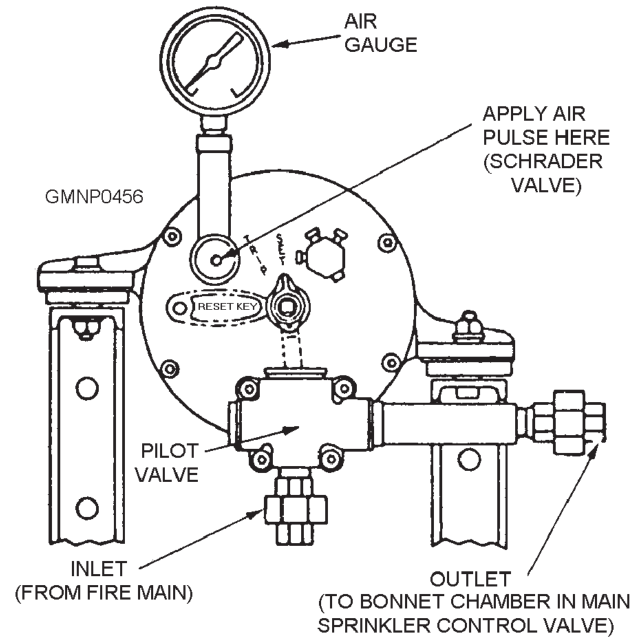

Figure 8-30.—Pneumatically released pilot value (PRP).

The outer body of the PRP valve is a circular bronze housing. Inside the housing is an operating mechanism, a diaphragm, and a compensating vent (fig. 8-31). The operating mechanism is a spring-loaded lever device connected to the diaphragm. The slightly flexible diaphragm is mounted inside an air chamber of the housing. The back side of the diaphragm chamber (or case) is connected to the HSD tubing network. The front side of the diaphragm is open to the interior of the PRP valve housing.

The compensating vent connects to the back side of the diaphragm chamber. Its purpose is to "leak off" any small increases or decreases in air pressure around the diaphragm. These variations are caused by normal space temperature or pressure fluctuations. The slow "leak off" serves to equalize the pressure on both sides of the diaphragm. In doing so, the compensating vent prevents inadvertent PRP valve actuation. The compensating vent is factory calibrated and adjusted, so do not make any "sailor alterations" to it.

Components outside the PRP valve housing include a hydraulic pilot valve, a Schrader valve, and an air-pressure gauge (see fig. 8-30). The pilot valve is installed in a saltwater line of the hydraulic control system. It rotates between a SET (closed) position and a TRIPPED (open) position. The pilot valve must be manually rotated back to its SET (closed) position with a special wrench (reset key).

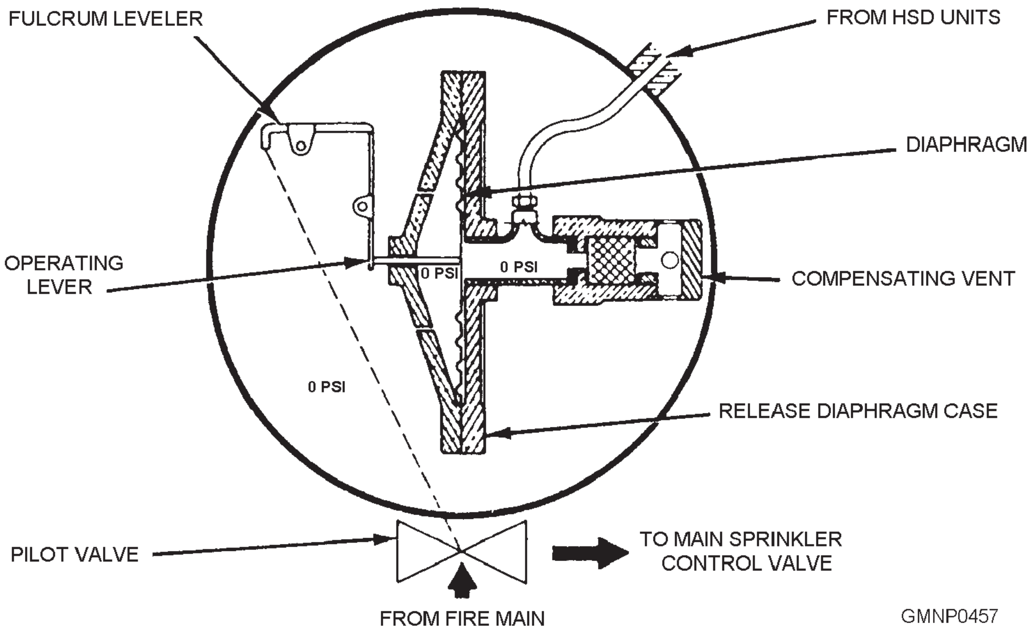

Figure 8-31.—PRP valve; internal schematic.

The Schrader valve is nothing more than an air valve stem (like that on a car or bicycle tire). It is only used during maintenance testing. Internally, it connects to the chamber area of the diaphragm. The air-pressure gauge monitors diaphragm chamber pressure ranging from 0 to 36 ounces per square inch (osi).

PRP VALVE OPERATION.—As space temperature rises, one or more HSDs activate. They transmit the air-pressure impulse signal to the back side of the flexible diaphragm of the PRP valve. If the increased pressure is of such magnitude that the compensating vent cannot bleed it off fast enough, the diaphragm will bend or move inward (fig. 8-31).

If the diaphragm moves far enough, it releases the lever of the operating mechanism. In turn, the lever rotates and trips the pilot valve. Salt water starts flowing through the hydraulic control system piping.

Hydraulic Control System

The components of the hydraulic control system are located on the local and remote control panels. (See fig. 8-28.) Various manual shutoff valves and strainers are used in the system. They isolate certain components during maintenance procedures and filter marine growth in the saltwater supply. Most of the valves are manufactured by the Cla-Val Company and are known by their Cla-Val designation.

LOCAL AND REMOTE CONTROL VALVES.—The local and remote manual control valves (fig. 8-32) are lever-operated rotary valves. Each one has three positions: OPEN, NEUTRAL, and CLOSED.

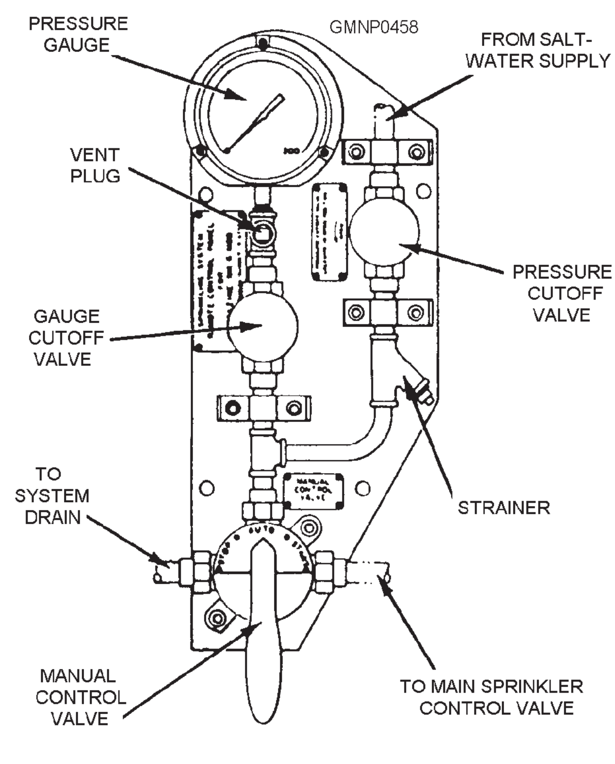

Figure 8-32.—Remote control panel.

The operating handle has a spring-loaded lever behind it. The lever actuates a locking pin that extends into a recess in the body of the valve. Three separate recesses or holes allow the valve to be locked in any of its three positions. Installed between the handle and the lever is a rectangular locking key. The key is secured in place by easily broken safety wire (lead-wire seal). The locking key prevents accidental sprinkler activation since the handle and lever cannot be squeezed together with the key in place. If they cannot be squeezed, the locking pin cannot be retracted and the handle will not turn.

INLINE CHECK VALVES.—Four inline check valves, designated Cla-Val No. 81M, are located on the local control board. (See fig. 8-28.) They are spring-loaded check valves that open wide when salt water flows in the proper direction (with the arrow). They close tight when salt water flows against the arrow. By preventing backflow to other stations, these check valves permit the sprinkler system to be activated from more than one station.

HYDRAULICALLY OPERATED CHECK VALVE.—The hydraulically operated check valve is designated Cla-Val No. 81PM-1 (fig. 8-28). It is a normally closed, globe-type check valve that becomes functional only during the stop cycle of sprinkler operation.

When fire main is ported to the upper chamber of the valve, its diaphragm lifts and opens the bottom chamber. Fire main from the top of the main sprinkler control valve is then ported out unrestricted to drain line #3. This action permits the main valve to close under spring pressure, which secures sprinkler operation.

DRAINS AND ORIFICES.—The hydraulic control system has three drain lines and two orifice restrictions (fig. 8-28). The drain lines are normally located so that they can discharge into a portable container (bucket). The lines should be numbered and tagged so that they can be quickly identified.

Drain lines #1 and #2 contain .098-diameter-orifice plates. The orifices (holes), drilled through flat metal plates, serve two purposes. The primary purpose of the orifices is to prevent a buildup of saltwater back pressure in control system piping. Back pressure is normally caused by valve leakage. Eventually, this back pressure could be enough to activate the system. On your daily magazine inspection, you will notice a puddle of water on the deck or in the bucket. Report it so that repairs can be made. The secondary purpose of the orifices is to vent operating pressure from the hydraulic control system when it is returned to AUTO or NEUTRAL.

Main Sprinkler Control Valve

The main sprinkler control valve is located inside the magazine. The valve (fig. 8-33) is a diaphragm-operated, normally (spring) closed, globe-type valve. The upper diaphragm in the bonnet chamber is raised or lifted by a minimum of 40-psi fire main pressure. As it lifts, the lower disc is pulled off its seat. Fire main supply is then free to flow to the sprinkler heads. The upper end of the valve stem can be seen in a glass sight tube. It provides a visual indication

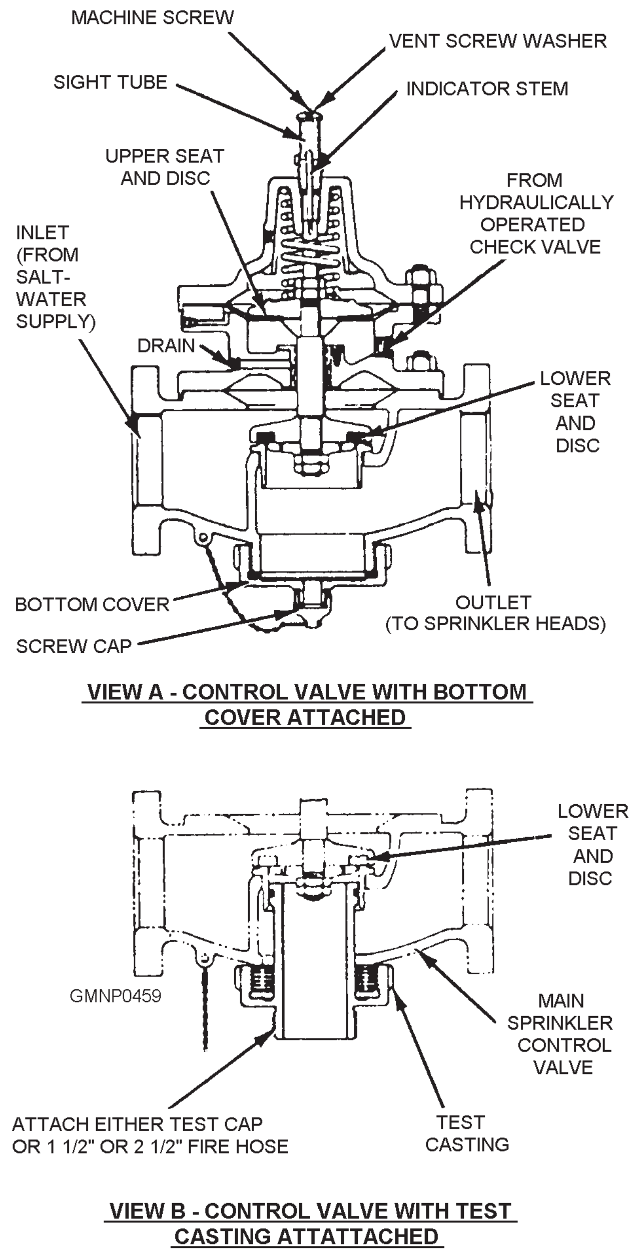

Figure 8-33.—Main sprinkler control valve.

of the condition of the stem (stem down, valve closed; stem up, valve open).

A removable cover is located on the bottom side of the body of the valve. Normally, the cover remains installed. During any maintenance testing or repair work, the cover is unscrewed and replaced with a special test casting (fitting).

The test casting is so shaped that it extends up to the lower seat of the disc. When the disc lifts, the fire main is prevented from flowing to the sprinkler heads by the body of the test casting.

The test casting also has a removable cap. When unscrewed, it may be replaced by a standard fire hose and fitting. After the system activates, the fire main flows through the hose and is discharged over the side. This process flushes the saltwater piping of the hydraulic control system.

The test casting MUST be installed before any work is performed on the sprinkler system. The test casting MUST be removed after the job is completed. These two "rules" are extremely important.

Sprinkler Alarm System

Two water-activated switches serve as the alarm portion of the system. Both units are located on the dry or downstream side of the main sprinkler control valve. (See fig. 8-28.)

The leakage alarm switch (fig. 8-34) is the early warning unit. The seat of the main control valve can become deteriorated through age. A piece of marine growth (like a seashell) can get caught on the seat when

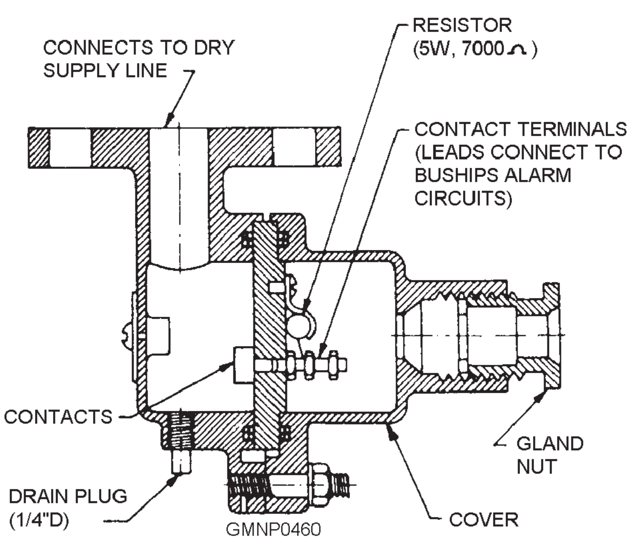

Figure 8-34.—Leakage alarm switch.

the valve closes. In either case, salt water will leak by and enter the switch body. Because water is a good conductor of electricity, it activates the switch element. An alarm is energized in DC central on the FH (water) circuit.

The operation alarm or flow alarm switch is installed farther downstream from the main valve. (See fig. 8-28.) When the system is activated, fire main pressure actuates this switch to set off other FH alarms in DC central.

Sprinkler System Operation

Refer to figure 8-28 as we describe a remote START and a remote STOP sprinkler operation. At the remote control station, the lead-wire seal is broken and the locking key removed. The handle and lever of the valve are squeezed together and turned to the START position. (When the locking pin engages its recess hole, you can let go of the handle.) Fire main control pressure flows through one of the inline check valves on the local board. (Trace the water flow on the figure.)

The control pressure flows to the top of the main sprinkler control valve, which lifts to start sprinkling operations. Control pressure also flows to the bottom chamber of the hydraulically operated check valve. A small amount of water flows out drain line #1. The other two drain lines will be dry at this time. (If you forgot to put the test casting in, your missiles are getting wet!)

When the system must be secured, the remote control valve handle and lever are squeezed and turned to CLOSED. Fire main control pressure is rerouted through the stop line to another inline check valve. Control pressure enters the upper chamber of the hydraulically operated check valve, causing it to lift. The control pressure in the upper chamber of the main sprinkler valve is then vented. It flows through the hydraulically operated check valve and out drain line #3. As the pressure decreases, the main sprinkler valve closes.

After the main sprinkler control valve has seated, the remote control valve may be returned to OPEN. Fire main control pressure is then isolated from the hydraulic control system. The hydraulically operated check valve will be closed by its spring as water pressure decreases. Any remaining pressure in the lines is bled through the #1 and #2 orifice drains.

The other operational possibilities will not be described in detail. The major steps for two such sequences are listed below. Refer to figure 8-28 as you run the cycles.

Remote station OPEN and local station CLOSED:

1. Remote—Turned to OPEN
2. Local—Turned to CLOSED
3. Remote—Turned to NEUTRAL
4. Local—Turned to NEUTRAL

Automatic (PRP valve) OPEN and remote station CLOSED:

1. PRP valve—Trips
2. Remote—Turned to CLOSED
3. PRP valve—Reset manually
4. Remote—Turned to NEUTRAL

Sprinkler System Maintenance

Sprinkler system maintenance is performed periodically under the Planned Maintenance System. We will describe some of the general procedures used during sprinkler testing. ALWAYS refer to the applicable maintenance instructions BEFORE per- forming ANY work.

> **NOTE**
>
> A test casting is treated as a controlled or accountable item. In other words, the commanding officer or a designated representative maintains custody of the test casting. Before any maintenance is started, two events must occur. First, permission must be obtained from proper authority to begin the work. Second, the test casting must be issued. After the work is finished, the test casting must be turned in. This issue/turn-in procedure assures command that the test casting is NOT accidentally left in the system.

The first rule is to install the test casting. (The chief will INSIST on that!) Connect the fire hose and fitting to the test casting if the system is to be flushed.

The next phase of the operation tests the automatic control system. Connect a tire (or bicycle) pump to the Schrader valve on the PRP valve. Stroke the pump slowly to pressurize the pneumatic system. That may take awhile as the entire pneumatic system is being filled. Do NOT exceed 16 osi on the air-pressure gauge during the pumping. Excess air pressure can damage the PRP valve/diaphragm.

When system air pressure balances or equalizes near 16 osi, disconnect the pump and wait 5 minutes. If the pressure stabilizes within the 8-16 osi range, the system is satisfactorily airtight. A pressure drop below 8 osi indicates an air leak, which must be repaired. Use a leak-detector solution to find loose or cracked transmission line fittings, cracked HSD bellows, and so forth.

If the system is "tight," CAREFULLY depress the stem of the Schrader valve. SLOWLY bleed the system to 8 osi. The PRP valve may, after repeated testings, be damaged if a higher pressure is used during the following step.

The next phase of the operation tests the PRP valve, hydraulic control system, and main sprinkler control valve operation. Fully depress the Schrader valve stem. The air from the front side of the diaphragm will be vented quickly to the atmosphere. The 8 osi of air on the back side of the diaphragm causes it to move. The operating mechanism is released, the pilot valve trips, and the system activates.

The system may be secured normally after it flushes for a few minutes. By the way, we hope you tied the end of the fire hose down. Unsecured, it will whip around under full fire main pressure.

When testing is completed, ensure ALL the air is bled from the PRP valve. That is done by depressing the Schrader valve stem. The test casting is removed as the final step. Take your time during sprinkler system tests. Be sure you are performing each step correctly.

The necessity to perform sprinkler system maintenance correctly cannot be overstressed. To emphasize this point, we will reprint a portion of an article that was published in the *Ships Safety Bulletin*. The Bulletin is a monthly publication prepared by the Naval Safety Center. The information contained in the Bulletin is intended for use by all hands. (The course number given at the end of the article may change, but otherwise the information remains valid.)

MAGAZINE SPRINKLING SYSTEMS

Inadvertent flooding of shipboard magazines are on the increase. Causes appear to be the unfamiliarity of personnel in operating and maintaining sprinkler system components, lack of formal training, improper supervision, and failure to follow prescribed PMS procedures.

In one incident, a group of three magazines was inadvertently sprinkled because the petty officer in charge failed to ensure that proper step-by-step PMS procedures were followed. In completing PMS, the technician restored system lineup before air test pressure was fully bled off the pneumatically released pilot valve (PRP). Personnel error and haste were at the root of this mishap.

NAVSEA OP-4, Vol. 2, Fifth Rev., Change 9, para. 3-22, requires that tests and maintenance of sprinkling systems be conducted in accordance with NAVSEA Technical Manual S9522-AA-HBK-010 and applicable PMS instructions. Formal training is available in the Sprinkler Systems School at the Fleet Training Centers in Norfolk and San Diego. Assistance can also be obtained from the Fleet Technical Support Center (FTSC) in your area.

Actual GMLS Dry-Type Sprinkler Systems

The dry-type, saltwater-operated, magazine sprinkler systems used by the Mk 13 and Mk 26 GMLSs and the Mk 41 VLS are similar. The remote control stations are located outside the launcher control rooms. The local control panels are located inside the magazine center areas. The HSDs and sprinkler heads are equally spaced around the missile cell/RSR areas.

The Mk 41 VLS has its own uniquely designed damage control system known as deluge. The deluge system applies water directly to a missile when a *restrained firing* or canister *overtemperature* occurs. *Restrained firing* is defined as missile motor ignition and subsequent rupturing of the canister after closure, without missile motion. *Overtemperature* is defined as an internal canister temperature of 190°F or above WITH a missile present. When either of the above conditions exists, a sensing device in the canister sends a deluge request to the deluge control circuits in the launch sequencer (LSEQ), which sends a DELUGE SYSTEM ON command to the motor control panel (MCP). The MCP determines which cell requires deluging and issues a DELUDE ON signal to cause deluging of that particular cell.

A deluge control assembly (fig. 8-35), containing a solenoid control assembly, check valve, pilot valve, deluge control valve, and associated plumbing, is provided for each cell in the module. All eight assemblies (five for the strikedown module) are mounted on the inboard side of the modules above the upper walkway.

A 28-gallon freshwater accumulator tank is filled with 15 gallons of freshwater and pressurized to

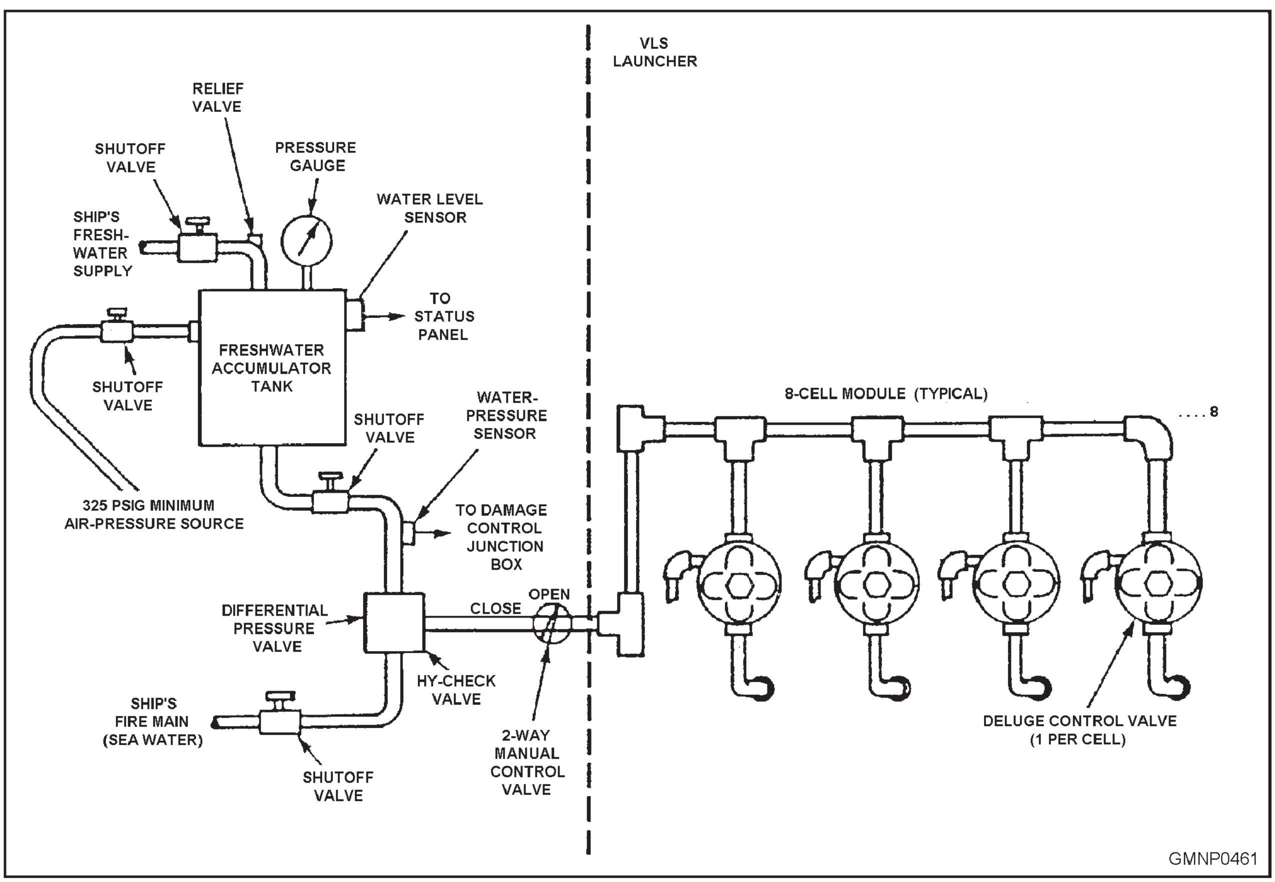

Figure 8-35.—Deluge water supply and components.

225 psi. An additional 50 gallons of freshwater is present in the launcher supply lines between the accumulator tank and the Hy-check deluge control valve. This water is used first, followed by the water from the accumulator tank. The water level in the accumulator tank is monitored by a sensing device. The sensing device sends a signal to both the status panel and central control station (CCS), causing an alarm indicating that the water level has dropped below 13 gallons. When the accumulator tank pressure drops below 190 psi, a signal is sent to both the status panel and CCS, causing another alarm. When the accumulator tank pressure drops below that of the ship's fire main, the Hy-check deluge control valve switches the system from freshwater to sea water to complete the deluge. The deluge flow rate is 40 gpm.

The deluge is secured by an internal reset signal originated by the launch sequencer (LSEQ) after 100 seconds ±10 seconds) or by manual operation of the DELUGE RESET switch on the status panel. A third method of securing the deluge is by operation of the deluge two-way manual control valve, which secures the saltwater supply.

When a deluge condition is initiated in a particular cell, any cell in that module which has been deluged before that time will be deluged again. This deluge operation will continue until the deluged canisters have been replaced. Also, any empty canisters in the module concerned are deluged.

ENVIRONMENTAL CONTROL SYSTEMS

LEARNING OBJECTIVES: Explain the role of environmental control systems used in guided-missile launching systems. Identify the major components or systems used in this process.

All GMLSs contain a variety of auxiliary systems that protect the launching equipment and missiles from excessive environmental conditions. Environmental control systems perform the basic functions of heating and cooling. Ship operations in the tropical climates will create high internal magazine temperatures and humidity levels. These conditions affect the reliability of missile propellant grains and play havoc with solid-state electronic control circuits. The colder climates also affect missile propellant performance and launcher component operation. If ice forms around movable guide-arm components, it could feasibly freeze or lock those components in place.

In many cases, the GMLS auxiliary systems rely on the ship's "hotel services" to operate. These services are the responsibility of the ship's engineering department. Steam from the boilers and chilled water from the cooling plants are two such services supplied to our equipments. In such cases, a little interdepartmental cross-training can be valuable.

ANTI-ICING SYSTEMS

Every GMLS has some type of auxiliary system that prevents the accumulation of ice formations around critical moving components. One such system is referred to as an anti-icing or circulating system. It is used to circulate a heated fluid throughout the equipments exposed to the weather. Another type of system uses an electrical coil or strip-type heating element to protect the exposed equipment.

Regardless of style, each system has the same end purpose—to melt the ice. Each GMLS also has its own version of an anti-icing system. We will briefly describe a typical system and then point out any unique differences between the GMLSs.

A Typical Anti-Icing System

The typical anti-icing system is an enclosed pressurized fluid system. Its main component is a heat exchanger tank (fig. 8-36). It is normally located in an auxiliary equipment room near the magazine and serves as a reservoir and heater for the anti-icing fluid. This fluid is normally a 50:50 mixture of ethylene glycol and water. The solution is similar to the antifreeze mixture in the radiator of your car.

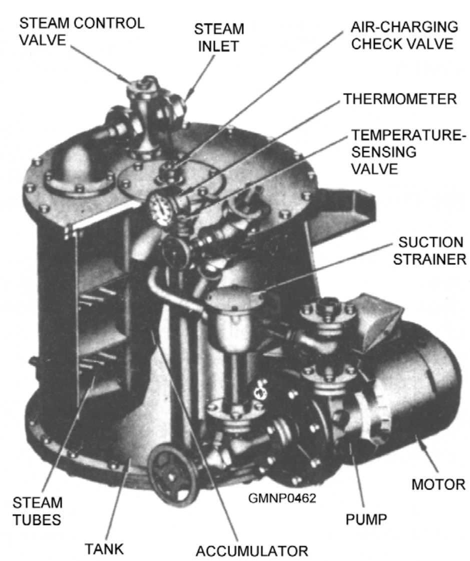

Figure 8-36.—Anti-icing heat exchanger tank.

Inside the heat exchanger tank is a coiled network of steam tubes. They are supplied by ship's auxiliary steam from the main or auxiliary (donkey) boilers. The tubes transfer heat to the anti-icing fluid as it (the fluid) flows through the tank. An air bladder (accumulator) inside the tank is charged with low-pressure air. The bladder acts on the fluid to keep a constant pressure in the system. The bladder also compensates for changes in fluid volume caused by temperature variations and minor leakage.

A steam control valve and a temperature-sensing valve monitor and regulate the temperature of the fluid. The sensing valve is installed in the return fluid line of the system and connects to the steam control valve. The sensing valve is adjusted to open and close the steam control valve within a selected temperature range. This action automatically maintains the anti-icing fluid within the desired heat range. Although the design specifications of each GMLS will vary, return fluid temperature is generally maintained between 40°F and 60°F. A thermometer is installed in the return line to monitor the temperature of the system.

A small electric motor is used to drive a centrifugal-type pump. The pump draws heated fluid from the tank and discharges it into the system. The supply and return fluid piping networks route the fluid throughout the critical areas of the GMLS. The piping system includes the normal variety of flow control, relief, and air-bleed valves. Strainers and distribution manifolds are also used. In many systems, anti-icing fluid is circulated through special internal passageways drilled or machined in a component.

In addition to circulating heated fluid, anti-icing systems can also run unheated. This optional feature circulates a cool fluid mixture used to help dissipate the heat created by a missile blast.

The anti-icing system in the Mk 26 is also used for missile blast cooling. When blast cooling is selected and a missile is fired, the system starts and runs automatically to circulate anti-icing fluid in the guided-missile launcher, blast door, jettison devices, blowout plates, and platform. The system runs for approximately 10 minutes after the last missile is fired.

Actual Anti-Icing Systems

The Mk 13 Mod 4 GMLS uses a heat source other than auxiliary steam. Twelve electrically controlled immersion heating elements are located within the heat exchanger tank of the Mk 13 Mod 4 GMLS. Each element is a 1/2-inch copper sheath about 6 feet long. It is bent into a loop that projects about l 1/2 feet into the tank. The copper sheaths are heated by single-phase, 440-VAC, 60-hertz power. They are energized through a heater-controller panel located near the launcher control room. Tank fluid is heated as it flows across the elements.

The Mk 41 VLS anti-icing system is designed to prevent a buildup of snow or ice that might prevent a cell or uptake hatch from opening during launch operations. The anti-icing system does not provide coverage of the strikedown hatch. Anti-icing must be manually enabled for each module individually at the launcher status panel.

The main items of the anti-icing system are heaters and thermostats built into the uptake and cell hatch assemblies (fig. 8-37). The uptake hatch contains one tubular 14-watt-per-inch heater element and two

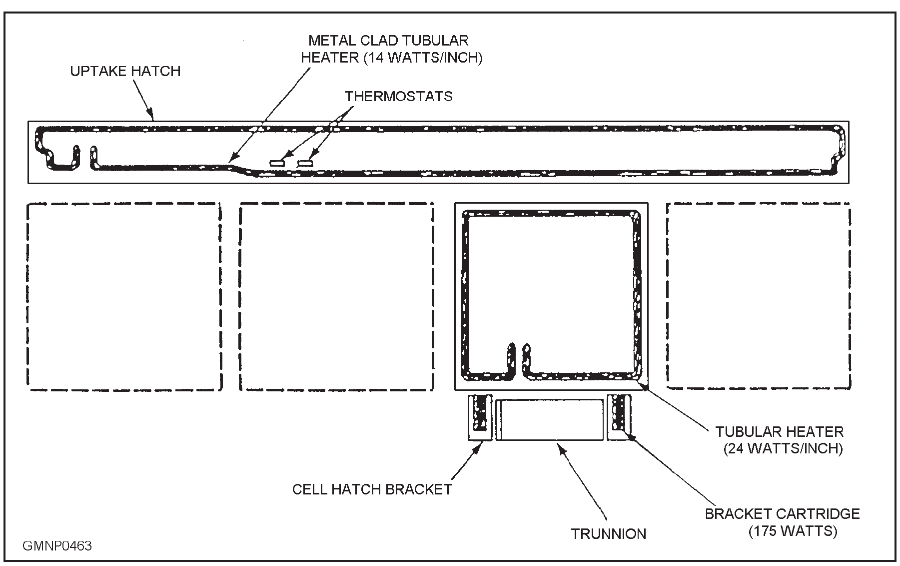

Figure 8-37.—Module hatch heater elements.

thermostats that activate the anti-icing system when the temperature falls within the 33°F to 43°F range. Each cell hatch has three heater elements; two of the heaters are 175-watt cartridge elements that are built into the hinge brackets on either side of the trunnion. The third heater is a 25-watt-per-inch tubular element built into the cell hatch cover and located around the perimeter of the hatch.

AIR-CONDITIONING AND VENTILATION SYSTEMS

Air-conditioning and ventilation systems are used in GMLS areas for the general safety of equipment, personnel, and the ship. The purpose of these systems is to circulate air around vital system components. This circulated air maintains normal temperature and humidity levels within a space. Air-conditioning systems use ship-supplied chilled water, a cooling-coil unit, and fan-blower units to circulate cool air. Ventilation systems only use a fan-blower unit to circulate ambient (surrounding) temperature air.

Launcher control rooms and missile magazines are always air-conditioned spaces. Some GMLSs use a separate ventilation system to cool their launcher carriages. Ventilation systems are usually thermostatically controlled to maintain space temperature ranges between (an average) 70°F and 100°F. Also, a majority of air systems have cutoff valves installed somewhere in the supply and exhaust lines. These valves should bear a Circle William damage control classification. Learn where these valves are located. They must be closed during nuclear, biological, and chemical (NBC) drills. Additionally, make SURE all air filters are cleaned properly on a strict maintenance schedule. That will keep these systems operating at peak efficiency.

Magazine air-conditioning/ventilating systems can also serve an important secondary purpose. Consider a missile magazine with an installed or fixed CO_2 system. If fire breaks out, the space will be flooded with CO_2 extinguishing agent. The air system must be secured quickly to prevent the CO_2 from being drawn out of the space. Normally, the CO_2 system has a pressure-operated switch that interconnects to the electrical circuit of the air system. When the CO_2 system activates, the switch secures the air system (turns off the blower).

The air system should not be turned on for at least 15 minutes after CO_2 discharge. This 15-minute time period serves as a cool-down period. The cool-down period prevents hydraulic fluids and lubricants from re-igniting when exposed to a new air supply. After the cool-down period, the space should be ventilated a full 15 minutes before anyone enters it. The air system removes the CO_2 gas and restores air to a life-sustaining level.

We will briefly examine the various air-conditioning and ventilation systems used in the GMLSs.

Mk 13 Mods 4 and 7 GMLSs

The magazine ventilating systems on the Mk 13 GMLSs use air, which is forced into the magazine, from the ship's air-conditioning system. It cools the missiles and inner structure (center column) equipment areas (fig. 8-38). Air enters the magazine through intake ducts under the cells. It flows up around the missiles and enters the inner structure through ventilation screens at the top of the structure. The exhaust ducts are in the center of the base.

Mk 26 GMLS

The Mk 26 GMLS and Mk 41 VLS use standard ship-operated air-conditioning units to cool their spaces. The Mk 26 has one unit that supplies the ICS and another that supplies the magazine.

GMLS SAFETY SUMMARY

LEARNING OBJECTIVES: Identify the safety precautions personnel use while working on guided missile launching systems.

The object of the last section of this chapter is to introduce you to the topic of safety. Specifically, we will emphasize certain safety precautions and warnings that apply, in general, to shipboard GMLS operations.

The Navy distributes many safety-related publications, periodicals, and special messages. Their contents are devoted entirely to important safety practices. Some are general in nature. Others deal with more specific precautions related to a single equipment or knowledge area. Certain general ordnance safety publications are also included in the GM3 through GMC bibliography list (NAVEDTRA 10052, current revision). These are references you should study when preparing for an advancement exam.

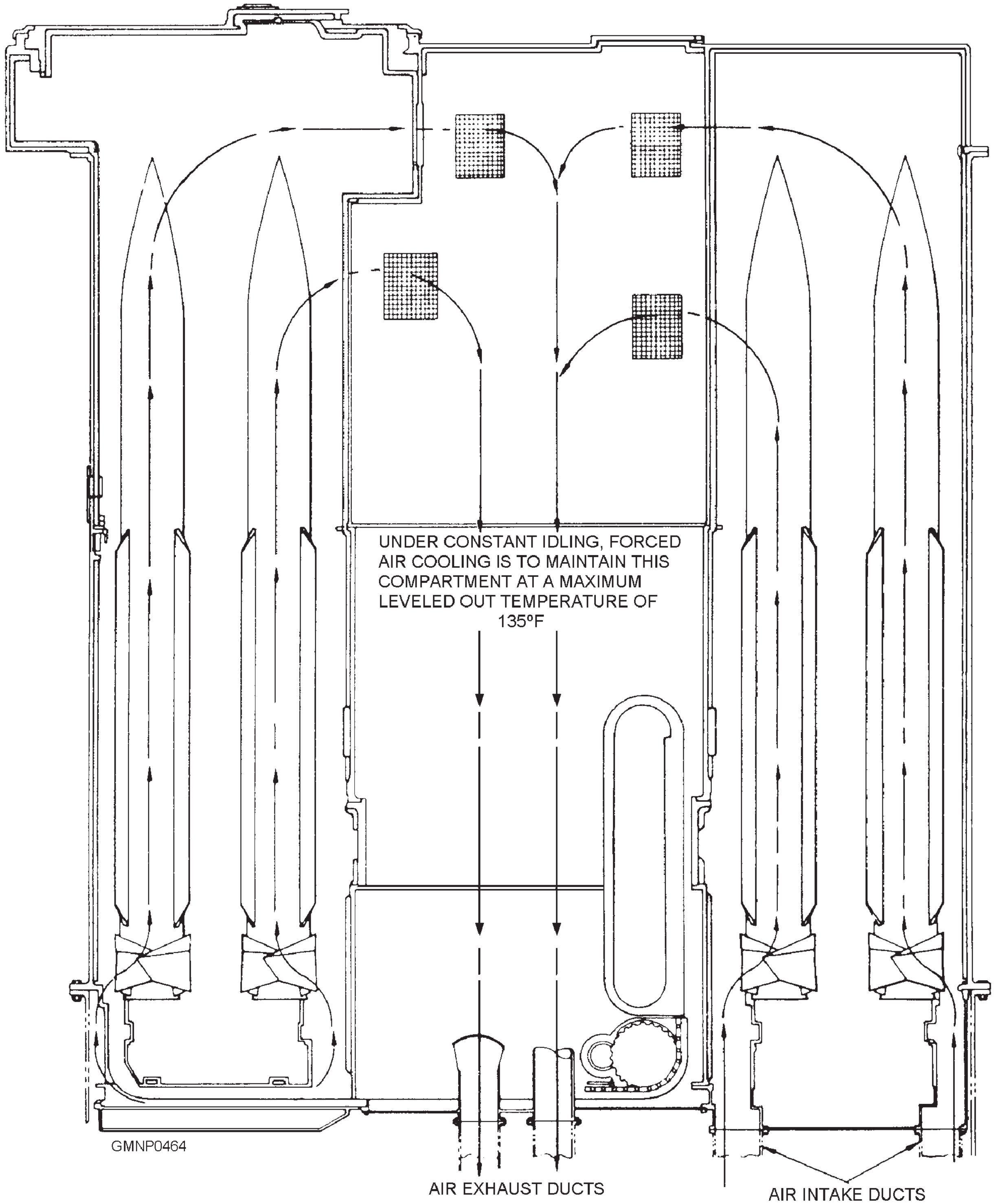

Figure 8-38.—Mk 13 GMLS magazine ventilation system.

Each launching system comes with a set of "books" called ordnance publications, or OPs for short. (They will be discussed in more detail later in this manual.) Published in a series of volumes, a GMLS OP describes the system and gives its operating procedures. Information and instructions needed to keep the equipment in proper working order are also included. Volume 1, which gives the description and operation of the GMLS, will always contain a section entitled "Safety Summary." The safety summary is usually given in two parts: (1) general safety precautions and (2) specific safety precautions.

GENERAL SAFETY PRECAUTIONS

General safety precautions, as the name implies, have wide applications in a variety of work-related situations. They pertain to the use of tools and to the exposure to high voltages and pressures. Additionally, they address the general safe handling of explosives and other volatile materials. Study these precautions so that you will recognize the potential hazards involved. Apply these precautions during all phases of operation and maintenance. The following precautions are a small sampling of warnings that pertain to all the GMLSs.

Establish Communications

Do not activate the launching system until communications have been established between the safety observer and the launcher captain.

High-Voltage Hazard

Be careful when working in lethal voltage areas. Do not work on live circuits unless absolutely necessary. Under some conditions, dangerous voltage potentials may exist in electronic circuits after the power is shut off. When such potentials are suspected, discharge the appropriate components before touching them. Do not perform work in a lethal voltage area under any circumstances without the presence of at least one person able to give first aid in the event of electric shock.

Resuscitation

Do not work with or near high voltages unless you are familiar with the methods of artificial respiration. Obtain resuscitation information from the appropriate authority.

Hydraulic Pressure Hazard

Always bleed the hydraulic systems of pressure before attempting to remove or disassemble any hydraulic component. Make sure system pressure is zero by observing installed gauges.

Hydraulic Fluid Hazard

If clothing becomes drenched with hydraulic fluid, immediately change into dry clothing. Hydraulic fluid is injurious to health when in prolonged contact with skin. It is also a fire hazard. Immediately wipe up spilled hydraulic fluid.

High-Pressure Water Hazard

Do not perform any maintenance procedures on the water injection system until all pressure in the lines has been dissipated. Do not work directly over water injection nozzles. Do not tamper or drop anything on water injection nozzles.

High-Pressure Air Hazard

Do not point a jet of high-pressure air at any part of a human body. The jet may be fatal.

High-Pressure Nitrogen Hazard

Use only approved nitrogen to charge accumulators. Never use oxygen or compressed air. A mixture of hydraulic fluid and oxygen is explosive. When charging accumulators, do not disconnect the charging line until it has been bled. High-pressure nitrogen is present in the charging line.

Carbon Dioxide (CO_2) Hazard

Suffocation hazard exists. Before entering the magazine area, unlock and close shutoff valve(s) for CO_2 system(s).

Live Missile Hazard

Return any live missile to the magazine before troubleshooting components in the launcher area.

Explosion Hazard

Do not take naked lights, matches, or other flame-producing apparatus into a compartment containing explosives. Smoking is not permitted at any time within these compartments.

Moving Equipment Hazard

When troubleshooting, shut down the power-drive motors of equipment not involved in the malfunction or casualty. After locating a fault, shut down all power-drive motors; then proceed with corrective actions.

Launcher Area Hazard

Ensure that the safety observer's safety switch (or deadman's key) is installed before entering the training area/circle of the launcher. Do not leave the switch unattended.

Unauthorized Panel Operation

Do not allow unqualified or unauthorized personnel to operate the control panels. Trainees or other persons undergoing instruction will operate panels under the strict personal supervision of a qualified and responsible operator.

Servicing, Adjusting Hazard

Do not reach into any equipment or enter the magazine structure to service or adjust components except with someone who can give first aid.

SPECIFIC SAFETY PRECAUTIONS

Specific safety precautions and warnings appear twice in a GMLS OP. They are stated near the equipment description or operating procedure to which they apply. They are also repeated in the second part of the safety summary for emphasis.

We will not attempt to list every specific safety precaution. The warnings given in the following paragraphs, however, can generally be applied to all the GMLSs.

Warning bells or horns will be sounded to alert all personnel of impending equipment movement. This movement could happen at any time. Do not start the power-drive motors without clearance from the safety observer. Verify all personnel and equipment are clear before moving the launcher.

Remove and retain safety switch handles or keys. That prevents the power-drive motors from being started when you are working on or around power-operated equipment. The launching system must be deactivated before personnel are permitted to fold missile fins inside the launcher area.

If a missile is on the guide arm, do not retract the aft-motion latch unless the hoist pawl is in full engagement with the aft missile shoe. Personnel must not pass or crawl through an open blast or magazine door with the system energized. Observing the clinometer, jettison on the down roll.

SAFETY SUMMARY CONCLUSION

Even though GMLSs are complex machines, they can be operated and maintained in a relatively safe manner. Safety precautions DO work if the proper equipment and procedures are used. All applicable safety warnings must be strictly followed. Always use your common sense and do not skylark.

All equipment operations should be performed carefully, methodically, and without hurrying. Greater individual and team effectiveness will be developed by increased familiarity with the proper and safe methods of accomplishing a task. Should a malfunction occur or an incorrect indication appear on a control panel, STOP the operation immediately. Then determine whether it is safe to proceed. Consider the effect of your decision on both equipment and personnel. Do NOT be afraid to ask for help.

Cleanliness and good housekeeping practices in all work areas are important. They are major factors in effective accident prevention. Keep tools in good working order, and always return them to a proper storage place.

Changes, modifications, or alterations to any ordnance equipments should not be made unless explicit authority from NAVSEA or another cognizant authority is obtained. Safety devices found on GMLS equipment were installed for the protection of personnel and equipment. These devices should never be removed, disabled, or bypassed. Specific authorization from the commanding officer or a designated representative is required if a safety device must be altered. Adequate notices should be posted to warn (and remind) personnel of the potential hazard.

This chapter only scratches the surface of safety. You will see more about safety throughout the rest of this manual. You will be involved with it everyday of your career. Become familiar with ALL the ordnance safety publications, and set the example in following them.

SUMMARY

In this chapter, we discussed the secondary and auxiliary functions of the major GMLSs. This discussion was primarily directed toward the procedures used in jettisoning and strikedown operations. We covered various fire suppression systems, including the CO_2, water injection, dry-type, and Mk 41 deluge systems. Environmental control systems—anti-icing and A/C—were also covered. The operational and safety requirements for the different types of sprinkler systems were also discussed.

We concluded the chapter with a safety summary on the GMLSs and a section on general safety precautions. It would probably serve you well to reread this section on safety.

In the next chapter, we will discuss the common electrical and electronic components and their schematic symbols, used in the current GMLSs.